

## Content of total polyphenols, vitamin C, mineral elements and the antioxidant activity of some dried fruits from the Romanian market

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### Abstract

The purpose of this paper was to analyze several types of dried fruits from the Romanian market (dates, brown raisins and figs) in terms of total polyphenols (Folin-Ciocalteu assay), vitamin C (iodometric method) and mineral elements (K, Ca, Mg, Fe, P, Mn, Cu, Cd, Zn, Pb, Cr, Ni) content (atomic absorption spectrophotometry) and also concerning their antioxidant activity (CUPRAC assay). From the three types of dried fruit analyzed, brown raisins were the richest in both total polyphenols ( $5.17 \pm 0.15$  mg gallic acid/g) and vitamin C ( $8.15 \pm 0.15$  mg/100g). Dried figs were richer in total polyphenols but poorer in ascorbic acid than dried dates. Regarding the antioxidant activity, it was the strongest also in the case of brown raisins ( $17.82 \pm 0.82$  mg Trolox/g), the dry dates registering the lowest value ( $14.08 \pm 0.25$  mg Trolox/g). Of the heavy metals analyzed, Cd was not identified in any of the dried fruits analyzed. Heavy metals: Cu, Cr, Ni, Pb and Zn, were below the maximum limit provided by law. Brown raisins were the richest in Fe, Mn, Mg, K, while dried figs recorded the highest concentration of Ca and P.

**Keywords:** dried fruits, polyphenols, vitamin C, mineral elements, antioxidant activity.

### 1. Introduction

Fruits are an extremely important part of the human diet. They are consumed both fresh and preserved. Drying the fruit is the healthiest solution for long-term storage. Another advantage of dehydrated fruits is that they have a much longer shelf life than frozen or canned fruits. In fact, dehydrated and stored in optimal conditions, the fruit can be eaten even after a few years [1,2]. Dried fruits can be eaten as such, but also as ingredients in some cakes or other preparations where can help to give much stronger flavors. They can also be turned into powder and then added to sauces or other foods. Another use can be the addition of dried fruit in yogurts, both for appearance and especially for taste [3].

Currently a very wide variety of dried fruits are produced, these being a very tasty and healthy snack. Of the many types of dried fruit, raisins, dates and figs are among the most common on the market. These are very rich sources of essential nutrients and bioactive compounds that support human health [4]. The content of various nutrients and bioactive compounds in dried fruits is influenced both by the variety, by the pedoclimatic conditions in which the plants grew but also by the drying methods applied and by the conditions and storage periods of the dried fruits [2].

Raisins contain a significant amount of glucose, fructose, nitrogenous substances, ash, arginine, fiber, minerals (Fe, Cu, Mg, B, Ca), vitamins (B1, B2, B5), catechins, etc.

They help in the proper absorption of vitamins, nutrients and proteins in the body and have a calming effect on the nervous system, helping to strengthen it. Raisins are also good for heart and lung health, fight constipation and help eliminate toxins from the body [5-7]. Numerous studies have shown the high content of polyphenolic compounds and the special antioxidant activity of raisins [8-11]. Regarding the fruit of the date palm, the edible part is the fleshy mesocarp, which exists between the epicarp and the hard endocarp. This fleshy mesocarp, in dried fruits, contains about 80% sugars, and about 20% is composed of proteins, lipids, dietary fiber, minerals (Ca, Fe, Mg, K, Na, Cu, Mn, Zn) and some vitamins [12, 13]. A number of studies have shown the richness of polyphenolic compounds in dates, proving to be powerful antioxidants, strengthen the immune system, protect against cancer and reduce capillary fragility [13-15]. Dried figs are also an important source of sugars, dietary fiber, polyphenols with high antioxidant properties, volatile substances, minerals (especially K, Mg, Ca, Na) [16-18].

This paper aimed to analyze some dried fruits from the Romanian market: brown raisins, dates and figs, in terms of vitamin C content (iodometric titrimetric method), total polyphenols (Folin-Ciocalteu assay), mineral elements (atomic absorption spectrophotometry), and also concerning their antioxidant activity (CUPRAC assay).

## 2. Materials and methods

The experimental determinations were performed on brown raisins (whole), dried figs (whole) and dried dates (only mesocarp), all this dried fruits being purchased from the Romanian market (supermarkets - imported products).

### 2.1 Determination of vitamin C, total polyphenol content and antioxidant activity

To determine the content of vitamin C (iodometric titrimetric method), total polyphenols (Folin-Ciocalteu assay) and antioxidant activity (CUPRAC method) the same methodologies were used as those presented by Dumbrava *et al.*, (2016) [19]. All experimental determinations were performed in triplicate, and the results were expressed as a mean and standard deviation (mean  $\pm$  SD).

### 2.2 Determination of the mineral elements content by atomic absorption spectrophotometry

For all three types of dried fruits (brown raisins, figs and dates) which were taken into study, the following mineral elements were determined by atomic absorption spectrophotometry: K, Ca, Mg, Fe, P, Mn, Cu, Cd, Zn, Pb, Cr, Ni. The way of working, the reagents and the equipment used were similar to those presented by Dumbrava *et al.*, (2020) [20]. Determinations were performed in triplicate, for each dried fruits sample, and the results expressed as mean  $\pm$  standard error

## 3. Results and discussion

### 3.1. Analysis of ascorbic acid content

Following the determinations of the ascorbic acid content in the dried fruit samples, by the iodometric titrimetric method, were obtained the results from figure 1.

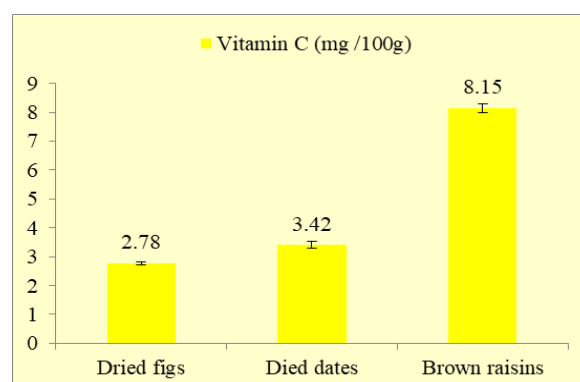


Figure 1. Vitamin C content in dried fruit samples

Among the three types of dried fruits analyzed, brown raisins had the highest content of vitamin C ( $8.15 \pm 0.15$  mg/100g) being more than 2 times higher than that of dried dates ( $3.42 \pm 0.11$  mg/100g) and almost 3 times higher than that of dried figs ( $2.78 \pm 0.05$  mg/100g). Olmo-Cunillera *et al.*, (2020) [21] determined an ascorbic acid content in different varieties of raisins of 2.30-3.20 mg/100g, a lower amount than the one we found.

Al-Farsi and Lee (2008) [22] found for dried dates an ascorbic acid content of 3.9 mg/100g, close to the value we found for our sample from the Romanian market. For fresh figs, Mahmoudi *et al.*, (2018) [23] found a vitamin C content of  $1.33 \pm 0.04 - 9.33 \pm 0.52$  mg/100g.

### 3.2. Analysis of total polyphenol content

The content of total polyphenols in the dried fruit samples, determined by the Folin-Ciocalteu method, is presented in figure 2.

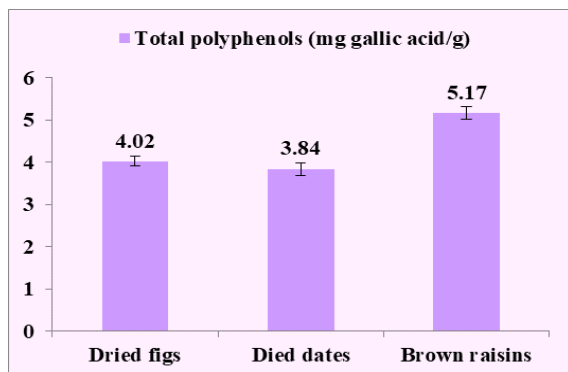


Figure 2. Total polyphenols content in dried fruit samples

We can observe, from the experimental data obtained, that also in terms of total polyphenol content, the highest value was again found in brown raisins ( $5.17 \pm 0.15$  mg gallic acid/g), followed by dried figs ( $4.02 \pm 0.11$  mg gallic acid/g) that have a value very close to that of dried dates ( $3.84 \pm 0.15$  mg gallic acid/g). Wu *et al.*, (2004) [24] reported a total polyphenol content in raisins:  $10.65 \pm 1.59$  mg gallic acid/g, in dried dates:  $5.73$ - $6.61 \pm 1.11$  mg gallic acid/g, and in dried figs:  $9.60 \pm 0.07$  mg gallic acid/g, all values being higher than those found by us in the analyzed samples, but the same as in our results, this content is higher in raisins, followed by dried figs and then dried dates. Di Lorenzo *et al.*, (2016) [9] found a concentration of total polyphenols in different varieties of raisins between  $2.26 \pm 0.12$  and  $161.33 \pm 3.63$  mg gallic acid/g, the values determined by us being in this range.

Kamiloglu and Capanoglu [18] found a concentration of total polyphenols in dried figs of 4.17 mg gallic acid/g, a value almost identical to that found in our analytical sample. Ahmed *et al.*, [13] reported in dry dates a content of total polyphenols between 2.92 and 4.61 mg gallic acid/g, very close to our experimental results.

### 3.3. Antioxidant activity analysis

The results regarding the antioxidant activity (determined by the CUPRAC method) of the analyzed dried fruits are presented in figure 3.

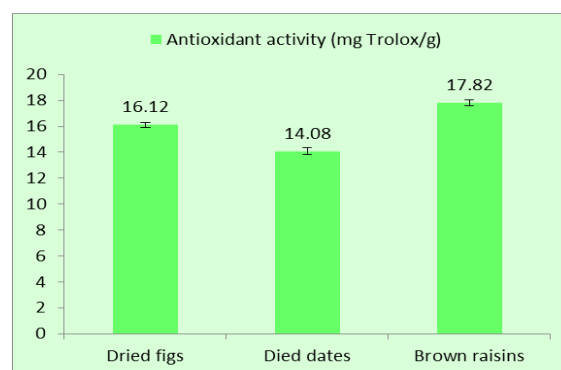


Figure 3. Antioxidant activity of dried fruit samples

In terms of antioxidant activity, brown raisins also have the highest value ( $17.82 \pm 0.23$  mg Trolox/g), followed by dried figs ( $16.12 \pm 0.19$  mg Trolox/g). We can see that although dried dates are richer in vitamin C than dried figs, the antioxidant activity of the latter is higher than that of dried dates, dried figs being more concentrated in polyphenolic compounds with significant antioxidant potential. Chang *et al.*, (2016) [2] reported a higher antioxidant activity for dried figs:  $33.83 \mu\text{mol TE/g}$  ( $8.46$  mg Trolox / g) than for raisins:  $30.37 \mu\text{mol TE/g}$  ( $7.59$  mg Trolox / g) and dried dates:  $23.87 \mu\text{mol TE/g}$  ( $5.97$  mg Trolox/g). However, all their results are lower than the values of the antioxidant activity determined by us for the three types of dried fruits.

### 3.3. Mineral elements analysis

Analysis of the minerals content from the three types of dried fruits on the Romanian market, performed by atomic absorption spectrophotometry, led to the results presented in figures 4a and 4b.

Figure 4a shows that K is the best represented element in all samples, the highest concentration being in brown raisins ( $32175 \pm 1002.52$  ppm), followed by dried dates ( $6097 \pm 147.52$  ppm) and then dried figs ( $5730 \pm 149.33$  ppm).

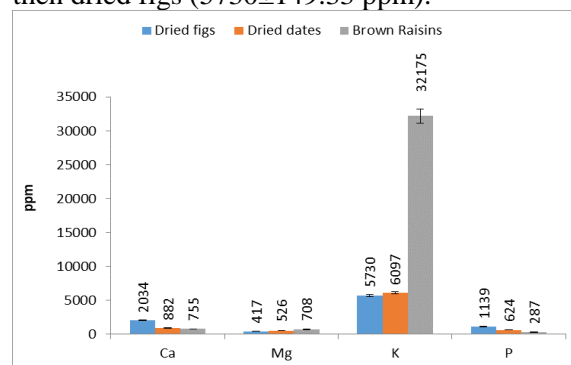


Figure 4a. Ca, Mg, K and P content in dried fruit samples

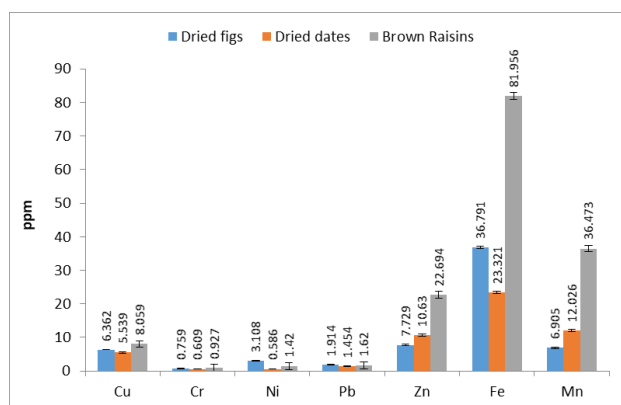


Figure 4b. Heavy metals in dried fruit samples

Dried figs are the best source of calcium ( $2034 \pm 39.51$  ppm) and phosphorus ( $1139 \pm 45.08$  ppm) among the samples analyzed, followed by dried dates ( $882 \pm 26.23$  ppm, respectively  $624 \pm 19.67$  ppm), brown raisins having a lower concentration in these elements ( $755 \pm 19.47$  ppm, respectively  $287 \pm 11.14$  ppm). The magnesium content was the highest in brown raisins ( $708 \pm 19.31$  ppm) and the lowest in dried figs ( $417 \pm 14.73$  ppm), dried dates having a content of  $526 \pm 18.38$  ppm.

Regarding the content of heavy metals (Figure 4b.), cadmium was not identified in any sample, and for the other heavy metals no exceeding of the maximum concentration allowed by law [25] was registered.

Brown raisins had the highest concentrations of iron ( $81,956 \pm 0.87$  ppm), manganese ( $36,473 \pm 0.56$  ppm), zinc ( $22,694 \pm 0.39$  ppm), copper ( $8,059 \pm 0.18$  ppm) and chromium ( $0,927 \pm 0.02$  ppm). The highest nickel and lead content was found in dried figs ( $3,108 \pm 0.07$  ppm, respectively  $1,914 \pm 0.02$  ppm), followed by brown raisins ( $1,420 \pm 0.03$  ppm, respectively  $1,620 \pm 0.02$  ppm).

Dried dates had a higher concentration of zinc ( $10,630 \pm 0.34$  ppm) and manganese ( $12,026 \pm 0.30$  ppm) than dried figs ( $7,729 \pm 0.23$  ppm, respectively  $6,905 \pm 0.21$  ppm), while dried figs were richer in iron ( $36,791 \pm 0.39$  ppm), copper ( $6,362 \pm 0.06$  ppm) and chromium ( $0,759 \pm 0.03$  ppm) than dried dates ( $23,321 \pm 0.37$  ppm,  $5,539 \pm 0.17$  ppm, respectively  $0,609 \pm 0.01$  ppm).

#### 4. Conclusions

- Of the three types of dried fruits on the Romanian market taken into analysis, brown raisins had the highest content of vitamin C and total polyphenols, having the strongest antioxidant activity.
- Although dried dates had a higher ascorbic acid content than dried figs, the latter had stronger antioxidant activity than dried dates due to their higher content of total polyphenols.
- The potassium content of brown raisins was of 5.3 times higher than in dried dates and of 5.6 times higher than in dried figs; also, brown raisins were richer in magnesium than the other two types of dried fruit, while the calcium and phosphorus content was higher in dried figs.
- Brown raisins are also distinguished by a much higher content of iron, manganese, zinc and copper than dried figs and dried dates.
- Regarding heavy metals, cadmium was not identified in any sample and all the others had concentrations below the maximum limits allowed by law.

**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.

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