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PHYSICOCHEMICAL PROPERTIES AND ANTIOXIDANT ACTIVITY OF SOME TROPICAL FRUITS

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ABSTRACT

They were determined the physical and chemical properties, antioxidant capacity and mineral content of tropical fruit respectively: : passion fruit (Passiflora edulis), carambola (Averrhoa carambola), sweet pepino (Solanum muricatum), guava (Psidium guajava), goldenberry (Physalis peruviana) and goji berries (Lycium chinense. Fruits were purchased on the market from imports. It was found a wide variability concerning fruits size and weight by species. The fruit size index ranged from 9.24 in goji berries to 75.78 in sweet pepino. The individual fruit weight ranged between 0.45 g in goji berries to 208.7 g in sweet pepino. The highest content of dry matter was found in passion fruit (27.59%) and the lowest value was recorded in sweet pepino (5.93%). Also, in goji berries and goldenberry we found high values of dry matter content. It is found that all analyzed species contain appreciable amounts of polyphenols, ranging from 26 201 mg/ l equiv gallic acid in goldenberry fruits and 141.966 mg / l gallic acid equiv in goji berries. The highest values of potassium content was found in goji berries (422.34 mg/100 g fm) while carambola fruit were recorded the lowest values (140 832 mg/100 g fm).

INTRODUCTION

Tropical fruits are an important source of fruit consumption worldwide. Because of their tropical flavours, and potential health benefits, consumers are seeking new taste experiences from exotic fruits (Cannon and Ho 2018). Tropical fruits are a source of biologically active compounds with anti-inflammatory potential (de Albuquerque et al. 2019). The presence of tropical fruits in Balkans and Romania by default is documented from ancient times. This is due to the links between our country and some Southern European countries and the Orient. Lately, due to connections with the EU which facilitated imports and commodity exchanges (Pröll et al. 2022), on Romanian market entered a number of fruits unknown to the public until now. The current demand for tropical fruit consumption has increased considerably with an unprecedented peak of 7.1 million tonnes (Nor, 2020). Research is ongoing to study the chemical characteristics and functionality of these fruits (Tavassoli-Kafrani et al. 2020; Picot-Allain et al. 2020; Altendorf 2018). Besides great taste, is scientifically proved that tropical fruits also provide many health benefits to ordinary people who suffer from diseases that require a special diet (M Villacorta J Shaw 2013). Unlike common fruits for fresh consumption, tropical fruits abound in exceptional nutrients, some in excess and therefore prohibited for those who suffer from certain diseases (Lawrence and Friel 2019). On the list of tropical fruits sold in Romania are: bananas, coconut, kiwi, pineapple, mango, papaya, pomegranate, etc. By introducing tropical fruits in usual diet can be beneficial, as long as there are no excesses of any view. Among the nutrient intake provided by tropical fruits we can mention: dietary fiber, minerals, vitamins and a diverse range of phytochemicals (Llorent-Martínez et al. 2013). From what we know up to now about the role of tropical fruits in the diet, we can say with certainty that they contain useful antioxidants in order to reduce the risk of cancer and heart disease and other substances which helps to regulate cholesterol and weight control (Pereira-Netto, 2018). Perhaps more than other fruits, tropical offers easy satiety and deserves to been introduced in eating and slimming diets especially between daily meals whereas they contain no calories, but can provide sufficient nutrients to successfully eliminate hunger between meals. However, do not forget that several of these fruits can have a higher content of sugar (Guevara et al. 2019) and therefore should be alternated with consumption of other fruits containing less sugar or various vegetables, only good for an unannounced snack. Tropical fruits are not just tasty (Waiyawuththanapoom & Tirastittam 2019), some trifles for festive meals in our country they are not popular but in countries where they are grown, doctors recommend them for thousands of years for healing.

MATERIAL AND METHODS

Plant material

As material we used the fruits of several species of tropical plants respectively: passion fruit (*Passiflora edulis)*, carambola (*Averrhoa carambola)*, sweet pepino (*Solanum muricatum)*, guava (*Psidium guajava*), goldenberry (*Physalis peruviana*) and goji berries (*Lycium chinense)* purchased from the market. The purchased fruits were subjected to analyses and determinations regarding their quality.

Analytical methotds

Physical properties. The following were determined for the fruit analysed: width (W), thickness (T), height (H) and individual weight (g). Also were calculated the size index (Im) and the shape index using mathematical formulas: Im = W+T+H/3 and Is = H/T. Dimensions were measured with a digital caliper, and the results were expressed in mm. Fruit weight was measured by weighing on an analytical balance results are expressed in grams.

Dry matter. The dry matter was measured by evaporating the water from the product in an oven at a temperature of 105^0 C and the results are expressed as a percentage.

Total soluble solids. Total soluble solids content (TSS%) was measured with a digital refractometer and the results are expressed as a percentage.

Titratable acidity. Titratable acidity was measured by titration of the aqueous extract of the sample with NaOH n/10 (Merck) in the presence of phenolphthalein as indicator. The results are expressed as g malic acid/100 g fw.

Ascorbic acid. The content of ascorbic acid, was measured using the iodometric method which consists in oxidation of ascorbic acid with iodine in an acid medium to dehydroascorbic acid in the presence of starch as an indicator, and the results were expressed as mg/100 g fw. The iodine required for the oxidation reaction results from the reaction between potassium iodate (Merck) and potassium iodide (Merck) in acidic medium.

Extraction. 3 g f fruits homogenates (3 g) were extracted with methanol (Sigma-Aldrich) (100 mL) in an ultrasonic bath for 60 min at room temperature (20 °C). The extracts were then centrifuged at 6000 rpm for 15 min and the supernatants were transferred to vials and used for total phenolic content tanins content and DPPH free radical-scavenging activity.

Total phenolics. Total phenolics content was determined by the Folin-Ciocalteu method (Obanda et al. 1997). Blue compounds formed between phenols and Folin-Ciocalteu reagent (Sigma-Aldrich), are independent of the structure of phenolic compounds, thus developing complex between the metal center and phenolic compounds. Absorption was measured at 765 nm wavelength and the total polyphenols content was expressed as mg/l gallic acid equivalents (Sigma-Aldrich).

Tanins content. The tannins were determined by Folin-Ciocaltou method (Jacob et al. 2021). 0.1 mL of the extract was added to a flask containing 7.5mL distilled water. 0.5 mL Folin-Ciocaltou reagent (Sigma-Aldrich) 1 mL Na_2CO_3 solution (Sigma-Aldrich) (35) and diluted to 10 mL with distilled water. The mixture was shaken vigorously and kept at room temperature for 30 minutes. Absorbance were measured against the blank at 725 nm with an UV/Visible spectrometer and was compared according to a standard curve od Gallic acid, the results being expressed mg of GAE/g (Sigma-Aldrich).

Antioxidant activity. The antioxidant activity was determined using the DPPH (1.1-diphenyl-2-pricrilhidrazil) (Merck), measuring the absorbance of the extracts (with hidrochloric acid 2%) (Merck), at 516 nm using a UV-VIS spectrophotometer. The results are expressed as a percentage using the mathematical formula RA= (1-the absorbance at 516 nm after 10 minutes/ the absorbance at 516 nm after 0 minutes) x 100.

Minerals content. The minerals content was determined by flame atomic absorption (AAS). The samples were prepared by wet digestion with concentrated nitric acid (Sigma-Aldrich) in a microwave oven and brought to constant volume (25 ml) with ultrapure deionized water after which they were filtered. The determination of mineral components was conducted using a mass spectrometer with flame atomic absorption and results were expressed in mg/100 g fresh weight. All tests were performed in triplicate and the results were expressed as average ± standard error of average repetitions.

RESULTS AND DISCUSSIONS

Results regarding the physical properties of the studied species are presented in table 1. From the data presented we can observe a wide variability of the fruits size and weight by species. The fruit size index ranged from 9.24 in goji berries to 75.78 in sweet pepino. The individual fruit weight ranged between 0.45 g in goji berries to 208.7 g in sweet pepino, results that are consistent with those found by Athmaselvi et al. (2014) on guavas and papaya. In terms of fruit shape index obtained values show that analyzed fruits have different forms from round (goldenberry) to ovate-oblong (goji berry). The results on the chemical composition and the antioxidant capacity of the fruit of the species studied are presented in Table 2. Data showed a large variation in the total dry matter (DM), and total soluble solids (TSS) of the fruits. The highest content of dry matter was found in passion fruit (27.59%) and the lowest value was recorded in sweet pepino (5.93%). Also, in goji berries and goldenberries we found high values of dry matter content. Yıldız et al, (2014) found a dry matter content of 18.67% in goldenberries. It appears that the fruits of the species studied have a very high content of vitamin C, ranging from 12.32 mg/100 g fm. in sweet pepino and 45.76 mg/100 g fm. in goji berries, higher values than those found in native fruits except gooseberries and quinces. Similar values were found by Silva and Abud (2017). Titratable acidity ranged from 0.26 g malic/100 g fm in carambola to 1.27 g ac malic/100 g fm in sweet pepino, lower values than indigenous fruits (cherry, plum), similar results as found by Silva and Abud (2017). Moreover it is known that fruits grown in tropical regions have a much lower acidity than those grown in temperate regions correlated with higher sugar content. Regarding the total polyphenols content, it is found that all analyzed species contain appreciable amounts of polyphenols, ranging from 26.201 mg GAE / l in goldenberry fruits and 141.966 mg GAE / l in goji berries, results being consistent with those found by Vasco C, Kamal-Eldin A and Ruales J in 2008. Only goji berries had a content in total polyphenols relative higher than that reported in domestic fruits such as apples with a total polyphenol content which varies according to the results presented by Vrhovsek et al (2004) between 66.2 and 211.9 mg/100 g sp. Tannins are phenolic compounds classified into hydrolyzable tannins (HT) and condensed tannins (CT). Tannins have many biological activities, such as anticancer, antioxidant, anti-inflammatory, anti-asthmatic, and antimicrobial activities (Maznim Abu et al. 2016). Tannin content ranged from 23.25 mg GAE/100 g fm in goldenberries to 127.80 mg GAE /100 g fm in goji berries. The data concerning the minerals content of the studied species are presented in Table 3. From the data, it is noted that the mainly element in these fruits is potassium, followed by calcium and magnesium. The highest values of potassium content was found in goji berries (422.34 mg/100 g fm) while carambola fruit were recorded the lowest values (140.832 mg/100 g fm). Also, goji berries contained the largest iron (2.56 mg/100 g fm) and boron values (0.65 mg/100 g fm). Passion fruit had the highest sodium (7.61 mg/100 g fm) and magnesium (127.73 mg/100 g fm) content while the highest magnesium content (51.64 mg/100 g fm.) was found in guavas. Similar values were found by Leterme et al. (2006) in starfruit, guave and passion fruit. The sodium content in the studied fruits was much higher than that of apple (0.6 mg/100 g fm) reported by Gorinstein at all (2001). Moreover, it is noted that the values of all studied species for the mineral content were much higher than those reported in the cited literature for apples.

CONCLUSIONS

Tropical fruit species exhibits great variability in size and shape. From the chemical point of view, they are characterized by a higher content of dry matter than fruits grown in temperate zones (apples) and high values of the contents in vitamins and soluble solids. The high content in polyphenols and vitamin C - main natural antioxidants, of these fruits give them a great nutritional value.

The selected tropical fruits represent a rich source of minerals. These tropical fruits could potentially be used to alleviate micronutrient deficiencies as a potent source of minerals.

Their consumption is recommended in our country especially during winter, when native fruits are found in small quantities in the market.

Table 1

Physical properties of the studied species

Species	Thickness (T) mm	Width (W) mm	Height (H) mm	Size index	Shape index	Weight (G) g
Passion fruit (*Passiflora edulis)*	57.78±4.6	55.47±5.1	62.33±5.7	58.52±4.6	1.07±0.4	59.03±4.3
Starfruit (*Averrhoa carambola)*	60.19±5.4	58.10±5.3	82.83±7.5	67.04±5.2	1.37±0.6	85.8±7.1
Pepino (*Solanum muricatum)*	71.18±6.8	65.60±5.9	90.58±7.9	75.78±6.0	1.27±0.4	208.7±16.5
Guave (*Psidium guajava*)	55.67±5.1	53.02±4.7	62.85±5,8	57.18±4.5	1.12±0.5	100.5±8.2
Goldenberry (*Physalis peruviana*)	20.26±1.9	19.57±1.3	1.63±0.7	19.82±0.6	0.96±0.2	4.8±0.3
Goji berries (*Lycium chinense)*	7.24±6,3	6.51±4.8	13.98±0.9	9.24±0.3	1.93±0.6	0.45±0.04

Table 2

Chemical properties and antioxidant activity of the studied species

Species	Dry matter %	Total soluble solids %	Tanins milliequivalent gram of gallic acid (GAE)/ 100 g fm	Ascorbic acid mg/100 g fm	Titratable acitidy (g malic acid/100 g fm)	Poliphenols milliequivalent gram of gallic acid (GAE)/ 100 g fm)	Antioxidant activity (RA) %
Passion fruit (*Passiflora edulis)*	27.59±1.40	12.72±0.71	24,64±1.30	19.36±0.98	0.064±0.004	28.986±1.2	2.9±0,12
Starfruit (*Averrhoa carambola)*	8.40±0.61	6.0±0.24	42.31±2.12	21.12±1.11	0.645±0.02	45.53±3.1	3.6±0.17
Pepino (*Solanum muricatum)*	5.93±0.42	4.6±0.19	40.5±2.09	12.32.0.59	0.045±0.001	44.58±2.1	3.84±0.2
Guave (*Psidium guajava*)	13.55±0.71	8.46±0.29	43.15±2.14	36.96±1.79	0.36±0.01	46.43±3.7	9.2±0.45
Goldenberry (*Physalis peruviana*)	19.65±1.08	14.5±0.71	23.25±1.13	42.24±2.06	0.15±0.02	26.20±2.2	8.48±0.49
Goji berries (*Lycium chinense)*	23.28±1.13	16.2±0.83	127.80±6.16	45.76±2.23	0.41±0.03	141.96±7.8	13.97±0.67

Table 3

The minerals content of the studied species (mg/100 g fm)

Species	Na	Mg	Al	Ca	Cr	Mn
Passion fruit (*Passiflora edulis)*	7.61±0.40	127.73±6.34	0.27±0.012	31.6±1.53	0.16±0.008	1.15±0.04
Starfruit (*Averrhoa carambola)*	3.07±0.13	30.51±1.51	0.163±0.008	3.24±0.15	0.12±0.004	0.31±0.01
Pepino (*Solanum muricatum)*	4.57±0.21	30.62±1.49	0.203±0.011	20.19±0.98	0.06±0.003	0.12±0.004
Guave (*Psidium guajava*)	2.71±0.10	51.64±2.56	0.25±0.011	33.16±1.62	0.14±0.005	0.48±0.022
Goldenberry (*Physalis peruviana*)	0.74±0.02	93.93±4.70	0.13±0.005	13.91±0.70	0.16±0.005	0.71±0.033
Goji berries (*Lycium chinense)*	3.23±0.15	69.52±3.45	0.25±0.013	24.83±1.19	0.31±0.01	0.64±0.029
Apples (Gorinstein et all, 2001)	0.6	5.02	-	4.26	-	-
Species	**Fe**	**Cu**	**Se**	**Ni**	**B**	**K**
Passion fruit *(Passiflora edulis)*	1.61±0.07	0.13±0.006	0.01±0.000	0.06±0.003	0.55±0.02	356.2±17,11
Starfruit *(Averrhoa carambola)*	0.98±0.05	0.038±0.019	0.003±0.000	0.025±0.001	0.34±0.01	140.832±6.96
Pepino *(Solanum muricatum)*	1.18±0.06	0.059±0.002	-	0.01±0.00	0.18±0.009	145.24±7.11
Guave *(Psidium guajava)*	1.91±0.08	0.35±0.015	-	0.01±0.00	0.56±0.02	228.38±11.22
Goldenberry *(Physalis peruviana)*	2.04±0.09	0.50±0.021	0.006±0.00	0.01±0.00	0.37±0.01	321.63±15.87
Goji berries *(Lycium chinense)*	2.56±0.13	0.52±0.02	0.006±0.003	0.016±0.001	0.65±0.03	422.34±21.12
Apples (Gorinstein et all, 2001)	-	-	-	-	-	81.9

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