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BIOCHEMICAL ATTRIBUTES OF SOME FIG (*FICUS CARICA* L.) GENOTYPES GROWN IN THE SOUTH-WEST REGION OF ROMANIA

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ABSTRACT

The aim of this paper is to make a brief characterization of some fig genotypes based on their biochemical composition. Fruit moisture, sugar content, total phenolic content (TPC) and macro/micronutrient content were determined for 14 fig genotypes from the South-West region of Romania. The fruit moisture values varied between 75.16 % and 84.68 % and the sugar content ranged between 18.15 % and 28.90 %. It was found that the dark skinned figs had the highest TPC (109.11 mg GAE/100g FW in S1 genotype), compared to the light skinned ones (14.64 mg GAE/100g FW in L1 genotype). Calcium and potassium were found to be the predominant macronutrients, followed by magnesium and phosphorus. Sodium, iron and zinc were found to be the most abundant micronutrients in the studied fig fruits.

INTRODUCTION

Ficus carica L. is an important member of the genus *Ficus.* The common fig is a tree native to southwest Asia and the eastern Mediterranean, and it is one of the first plants that were cultivated by humans (Shukranul et al. 2013).

Ficus (Moraceae) genus is an important genetic resource due to its high economic and nutritional values and also an important part of the biodiversity in the rainforest ecosystem (Shukranul et al. 2013). The fig is an important harvest worldwide for its dry and fresh consumption.

Figs represent a notable source of phenolic compounds, such as proanthocyanidins, whereas red wine and tea, which are two good sources of phenolic compounds, contain phenols lower than those in fig (Auger et al. 2004).

Fig fruit (consumed either fresh or dried) is a rich source of polyphenols distributed throughout its peel and pulp (Jatinder et al. 2022).

Numerous studies have been made in order to better describe and assess the nutritional value and quality of figs (Khapre & Satwadhar 2011, Tanveer et al. 2016, Sadia et al. 2014, Marwa et al. 2019).

In Romania, figs have also adapted in some regions and research have also been made (Stănică et al. 2021, Stănică 2017), but fig cultivation in Romania is still strictly limited in specific regions where the climate is milder and the trees have adapted properly. Even so, it is important to continuously find and preserve valuable biological material. The aim of this paper is to describe, based on their biochemical composition, fourteen fig genotypes collected from the South West region of Romania.

MATERIAL AND METHODS

The biological material was collected from two locations of the South-West region of Romania, Svinița village (44°32′11″N 22°05′15″E) and Orșova town (44°43′ 31″N 22°23′46″E) which is 48 km away from Svinița. From the total of fourteen studied genotypes, four were collected from Svinița (S1, SV1, SV2, SM1) and the other ten (C1, C2, C3, M0, M2, F1, F2, F3, L1 and IJ1) from different parts of Orșova town. The genotypes have been encoded through letters and numbers, to make it easier for further recognition and description. The biological material was chosen based on their fruit appearance, efforts being made to find as much diversity as possible among the genotypes.

The moisture content was determined using the method described and approved by the International Organization for Standardization: SR ISO17025/2005; ISO 1442/1997 (ISO, 1997). In a drying oven were introduced circa 5 g of fresh fruit sample at the temperature of 103 °C for a duration of six hours. After the drying process ceased the moisture content was calculated with the formula: % Water = $\frac{(G1-G2)}{(G1-G3)}$ x 100, where G1 is the weight of the plate and the sample before drying; G2 is the weight of the plate and the sample after drying and G3 is the weight of the empty plate.

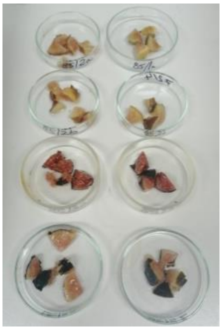

Fig. 1 Sample weighting

Fig. 2 Samples prepared for drying

Fig. 3 Samples during drying process

The sugar content was determined based on the soluble dry matter read on the refractometer (ATAGO Co., Tokyo, Japan) using the formula: Sugar (%) = [(dry matter x 4.25) / 4] - 2.5 (Bona A. & Iordănescu O. A., 2019).

The Total Phenolic Content (TPC) was determined by using the Folin – Ciocalteu method and TPC content determination was made with an UV-Vis

Spectrophotometer model SPECORD 210 – Analitik Jena. The results were expressed as *mg gallic acid equivalent/100 g fresh weight* (Ciulca, S. et al. 2021).

For all these determinations the final data were statistically processed and interpreted using analysis of variance (ANOVA) method (Bona A. & Iordănescu O. A., 2019).

The macro and micronutrient content was determined with the standard method SR EN 14082: 2003 – for food products using the ASS method (atomic absorption spectrophotometry) (Labun P & Salamon I., 2013). The equipment used for the identification of the elements was an atomic absorption spectrophotometer model Varian SpectrAA 220. After calculations were made, the results were expressed as *ppm* (Iram K. et al., 2016).

RESULTS AND DISCUSSIONS

Tables 1 – 3 present the statistical interpretated data regrading the biochemical aspects of the studied fig genotypes. Table 1 shows how the moisture content percentage varied from one genotype to another with the highest value in F3 (84.68 %) and the lowest in C1 (75.16 %). In Table 2 is presented the sugar content which recorded an average value of 24.28 %. In table 3 can be observed the variation of TPC in the studied figs. The content in macro and micronutrients is presented in Table 4 andTable 5.

Table 1

The **moisture values** in the studied fig genotypes

Genotype	**Moisture content** %	Relative value %	Difference	Significance
C1	75.16	95.42	-3.61	00
C2	76.09	96.60	-2.68	0
C3	78.49	99.64	-0.28	-
M0	80.66	102.40	1.89	-
M2	75.95	96.42	-2.82	00
S1	76.62	97.27	-2.15	0
SV1	79.29	100.66	0.52	-
SV2	76.17	96.70	-2.60	0
SM1	77.69	98.62	-1.08	-
F1	75.75	96.17	-3.02	00
F2	81.91	103.98	3.14	XX
F3	84.68	107.50	5.91	XXX
L1	82.20	104.35	3.43	XX
IJ1	82.18	104.32	3.41	XX
Average	78.77	100.00	0.00	Control
LD5% = 2.03% LD1% = 2.75% LD0.1% = 3.66%				

The moisture content of the fruits varied between 75.16% (C1) and 84.68% (F3), with an experience average of 78.77% (Table 1).

Fruit moisture values above the average were recorded in six out of the fourteen studied genotypes, only one being very significant positive compared to the experience average (F3), three genotypes were distinct significant positive (F2, L1 and IJ1), while four genotypes were not statistically assured (C3,M0, SV1 and SM1) (Table 1).

Fruit moisture values below the average were recorded in C1, M2 and F1 all three being distinct significant negative compared to the experience average. C2, S1 and SV2 genotypes were significant negative and C3, M0, SV1 and SM1 were not statistically assured.

Other studies showed similar moisture values of 78.8 % (A.P. Khapre & P.N. Satwadhar, 2011), 86.57 %, 82.46 %, 85.63% and 79.64 % (Tanveer et al. 2016).

Table 2

The **sugar content value** in the studied fig genotypes

Genotype	**Sugar content** %	Relative value %	Difference	Significance
C1	27.70	114.05	3.41	XXX
C2	25.26	104.01	0.97	XX
C3	28.90	119.00	4.61	XXX
M0	21.20	87.29	-3.09	000
M2	26.54	109.28	2.25	XXX
S1	24.33	100.19	0.05	-
SV1	21.63	89.07	-2.65	000
SV2	25.75	106.03	1.46	XXX
SM1	25.33	104.31	1.05	XX
F1	27.70	114.05	3.41	XXX
F2	24.20	99.64	-0.08	-
F3	21.10	86.87	-3.18	000
L1	22.30	91.81	-1.98	000
IJ1	18.15	74.734	-6.13	000
Average	24.29	100.00	0.00	Control
LD5% = 0.68 % LD1% = 0.92 % LD0.1% = 1.22 %				

The sugar content of the studied fig genotypes varied between 18.15 % (IJ1) and 28.90 % (C3), with an experience average of 24.29 % (Table 2).

The highest values of the sugar content in the fruits were recorded in C3, C1, F1, M2 and SV2 genotypes all being very significant positive compared to the experience average (Table 2).

Sugar content values below the average were recorded in M0, SV1, F3, L1 and IJ1 being very significant negative compared to the experience average, while S1 and F2 were not statistically assured (Table 2). Similar values of the sugar content are shown in other studies 12 to 21.3 % (Koyunku et al. 2004) and 16.6 % - 20.0 % (Polat & Çalişkan 2008).

Table 3

The **Total Phenolic Content (TPC) values** in the studied fig genotypes

Genotype	**TPC** mg GAE/100g FW	Relative value %	Difference	Significance
C1	90.10	140.48	25.96	XXX
C2	88.44	137.88	24.30	XXX
C3	93.16	145.24	29.02	XXX
M0	26.08	40.66	-38.06	000
M2	99.67	155.40	35.53	XXX
S1	109.11	170.11	44.97	XXX
SV1	96.08	149.80	31.94	XXX
SV2	37.73	58.82	-26.41	000
SM1	19.63	30.60	-44.51	000
F1	88.26	137.61	24.12	XXX
F2	24.00	37.42	-40.13	000
F3	84.96	132.47	20.82	XXX
L1	14.64	22.83	-49.49	000
IJ1	26.14	40.75	-38.00	000
Average	64.14	100.00	0.00	Control
LD5% = 1.60 mg GAE/100g FW LD1% = 2.17 mg GAE/100g FW LD0.1% = 2.88 mg GAE/100g FW				

The total phenolic content (TPC) found in the studied fig fruits had very different values from one genotype to another, with TPC ranging between 14.64 mg GAE/100g FW in L1 and 109.11 mg GAE/100g FW in S1, with an experience average of 64.14 mg GAE/100g FW (Table 3).

Other authors mentioned total phenolic contents varying from 51.50 to 100.23 mg GAE/100 g (Fateh Aljane et al. 2020), 24 to 237 mg GAE/100 g (Ercisli S. et al. 2012) and 73.74 mg GAE/100 g - 201.77 mg GAE/100 g FW (Marwa et al. 2019).

In our study, dark skinned fruits recorded the highest TPC (e.g. C1, C2, C3 etc.) compared to the light skinned genotypes (M0, SV2, F2 etc.). Several authors have reported the great contribution of fruit skin (compared to pulp) to these compounds especially in darker varieties (Fateh Aljane et al. 2020, Jatinder et al. 2022, Marwa et al. 2019).

Table 4

The macromineral content in the studied fig genotypes

Genotype	**Macromineral content (ppm)**				
	P	**K**	**Ca**	**Mg**	**Na**
C1	120.6	1110.9	1325.767	296.3521	35.4832
C2	201.5	1647.4	987.869	311.3726	33.4255
C3	168.4	1389.5	1137.326	302.634	40.9025
M0	60.3	1537.5	451.844	189.793	29.5965

M2	110.6	1236.1	1164.865	310.145	32.9865
S1	123.8	1132.9	1299.927	295.2999	34.9853
SV1	199.8	1741.7	998.663	291.3819	45.6974
SV2	43.3	1030.9	367.622	134.9493	33.4130
SM1	47.2	633.03	387.269	131.2196	33.9392
F1	124.5	1158.5	1330.523	309.4236	36.0784
F2	56.5	1252.7	463.079	171.1852	42.2074
F3	72.1	1364.3	272.341	454.5454	31.3472
L1	49.3	1872.5	426.692	162.6129	23.8141
IJ1	105.2	1168.2	613.476	250.8417	30.3460

The highest value for calcium (1330.523 ppm) was recorded in C1 and the lowest in F3 (272.341 ppm). Potassium was highest in L1 (1872.5 ppm) and lowest in SM1 (633.03 ppm). F3 recorded the highest magnesium content (454.5454 ppm) and SM1 the lowest (131.2196 ppm). Sodium recorded some of the lowest values of all macronutrients, ranging from 23.8141 ppm (L1) to 45.6974 ppm (SV1) (Table 4).

Table 5

The micromineral content in the studied fig genotypes

Genotype	Micromineral content (ppm)			
	Fe	**Mn**	**Cu**	**Zn**
C1	5.631	1.898	1.147	3.7341
C2	4.648	1.912	1.136	3.6322
C3	5.943	1.521	1.025	3.4895
M0	5.023	1.268	0.852	2.7454
M2	5.387	1.894	1.142	2.5798
S1	4.771	1.928	1.029	3.8361
SV1	6.613	1.904	1.456	2.2300
SV2	3.719	0.793	0.761	3.8949
SM1	3.677	0.803	0.882	2.2610
F1	7.017	2.051	1.117	4.1073
F2	4.733	1.013	0.969	4.4402
F3	6.461	0.889	1.250	3.479
L1	3.648	0.917	0.995	1.7488
IJ1	4.844	1.129	1.024	2.0957

Regarding the micronutrient content, iron was found in highest amounts with values raging between 7.017 ppm (F1) and 3.648 ppm (L1), followed by zinc, manganese and copper (Table 5). Regarding tables 4 and 5, other authors mention similar amounts of mineral nutrients found in the fig fruit, such as: 10940 ppm calcium (Mohammed O. A. et al. 2020), 357 mg/100g potassium (Khapre & Satwadhar 2011). Sadia et al. 2014, in their study on some wild edible fig found Mg amounts of [(6.92 ± 0.37 mg·g^{-1}] and K [(17.21 ± 0.03 mg·g^{-1}].

CONCLUSIONS

The result following this research showed that the fig genotypes that grow in the South – West region of Romania give fruits with high nutritional value. It was observed how rich the TPC is in some studied fig genotypes, and how high are the differences in value, e.g. S1 recorded 109.11 mg GAE/100g FW, while L1 only 14.64 mg GAE/100g FW. This difference being marked by so many authors stating the fact that dark skinned figs are the richest in TCP. Because of this, it is recommended to consume the dark skinned figs fresh or dried to make accessible to the organism all the nutritional aspects of the TPC, while the light skinned ones to be processed in jams, jellies, special drinks or any other form of processing to preserve as much as possible their natural sugar content and flavour. The content in macro and micronutrients as presented in Table 6, showed the high content of the fruits in calcium, potassium, magnesium, iron, zinc and sodium, making them a very complete type of food that can be accessible to anyone, as long as the fig cultivation develops in the favourable regions, this making possible to put on the market figs that are locally produced.

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