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Evaluation of some nutritional parameters of dried figs

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Abstract

Dried figs are an important nutritional and energy source in human food, these containing increased amounts of essential nutrients in a rational proportion: carbohydrates, dietary fiber, sugars (especially fructose and glucose), proteins, organic acids, minerals, vitamins, enzymes phenolic compounds and phytochemicals. In addition, these fruits have remarkable pharmacological properties, such as antioxidant, anticancer, cytotoxic, anti-inflammatory and hypolipidemic activities.

This study aims to evaluate the nutritional profile of some brands of sun-dried figs imported from Mediterranean countries and sold on markets in the city of Timisoara. The following nutritional parameters were determined from the analyzed samples: moisture, total minerals (ash), proteins, carbohydrates, ash and dietary fiber.

The obtained results show that these fruits contain important amounts of carbohydrates, proteins, dry matter, dietary fiber and low fat contents, distributed in wide concentration limits. Therefore, the consumption of nutritional principles present in the composition of figs has a beneficial effect on the health of the body.

Keywords: dried figs, nutritional parameters, Mediterranean figs

1. Introduction

Fig, the fruit of the Ficus carica L. tree (family Moraceae) grown mostly in the Mediterranean climate, but also in wetter regions, including tropical and subtropical areas or in other countries with warm summers and mild winters [1, 2, 3], is one of the oldest forms of food known to man [4, 5, 6]. These fruits were among the most popular fruits not only because of their pleasant taste, but also because of their medicinal properties [7]. Figs have traditionally been used to cure many diseases as a stimulant, laxative, emollient, resolving cough suppressant, emmenagogue and for constipation, hemorrhoids and hypercholesterolemia [4].

Fresh or dried, figs are considered important natural foods in human nutrition, especially in the Mediterranean diet based on the fact that these fruits contain significant amounts of essential nutrients in a rational proportion [8]. Figs are a good source of carbohydrates, including fiber, sugars (fructose and glucose are the major sugars in figs), proteins, organic acids, phenolic compounds and phytochemicals. [9, 10, 11,12, 13]. Also, figs contain increased amounts of minerals, the important mineral elements are K, Ca, Mg, P, Na, Zn, Fe, Cu, but also vitamins and enzymes [9, 12, 13, 14, 15, 16]. In addition, these fruits are easy to digest and have a cleansing effect on the blood and digestive tract [8]. The composition depends on several factors, such as soil, climate, genotype, maturity and technological aspects [11].

The quality of figs is determined by the nutritional and bioactive composition, but also by other parameters related to sensory characteristics, including firmness, visual appearance, taste and aroma [11]. This fruit has a nutritional index of 11, compared to other fruits such as apples, raisins and dates that have nutritional indices of 9, 8 and 6 [1].

In addition, *Ficus carica* has remarkable pharmacological properties, such as antioxidant, anticancer, cytotoxic, anti-inflammatory and hypolipidemic activities [17]. Numerous medicinal

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virtues have been attributed to this fruit, considered a food to invigorate the body that helps to recover quickly after a prolonged illness, which removes physical and mental effort and gives the body vigor and strength [1]. Figs have also been reported to have anticancer, antioxidant, antidiabetic, hepatoprotective, antifungal, antimutagenic, anti-inflammatory, antibacterial, and cholesterol-lowering activity [1, 18].

Because fresh figs are very sensitive to microbial damage, even in cold storage they must be kept in a certain way [6,19]. Drying is one of the most common forms of preservation of figs, as it has a great effect on quality of dry products [6, 20]. *Ambika Chauhan et al*., 2015 showed that drying techniques improved the content of protein, carbohydrates, ash, dietary fiber (neutral detergent fiber, acid detergent fiber, cellulose, hemicellulose and lignin), total phenol, antioxidant activity and mineral content [21]. The same authors reported that drying destroys the total content of flavonoids, tannins, alkaloids and anthocyanins [21]. As such, figs are largely consumed in dried or pre-dried form and processed with chocolate, ice cream, jam, biscuits or to obtain a syrup known as fig honey [6, 19, 22].

Dried figs, compared to fresh figs, contain higher amounts of essential nutrients, because the nutrients are more concentrated in solids when water is removed. In addition they have the advantage that they can be available for consumption throughout the year [2, 12]. The nutritional and therapeutic qualities of dried figs are mentioned in numerous specialized works in which the nutritional parameters of this fruit considered as a medicinal food are highlighted. Thus, dried figs are rich in carbohydrates, sugars, minerals, vitamins, dietary fiber, organic acids and phenolic compounds and energy [2, 5, 10, 14, 23, 24]. According to USDA, dried figs are an excellent source of fiber, vitamin K and minerals such as copper, manganese, magnesium, potassium, calcium in relation to human needs [2].

Ambika Chauhan et al., 2015 showed that drying techniques improved the content of protein, carbohydrates, ash, dietary fiber (neutral detergent fiber, acid detergent fiber, cellulose, hemicellulose and lignin), total phenol, antioxidant activity and mineral content of figs [21]. The same authors reported that drying destroys the total content of flavonoids, tannins, alkaloids and anthocyanins [21].

Analyzing the nutritional profile of dried figs (Ficus carica) collected from a local market in *Panipat, Haryana, India, Neha Soni et al.*, 2014 [2], found that these fruits are a good source of carbohydrates (73.50%), minerals (4.65% ash) and energy (317.78 kcal), with an average content of protein (4.67%) and dietary fiber (3.68%) and very small amounts of fat (0.56%). Dried figs contain 16.53% moisture. Relatively similar results, in the analysis of dried figs from the Crawford market (Mubai) were obtained by *Vora et al.:* 1.8% protein, 0.959% fats, 60.0% carbohydrates, 61.96% moisture, 7.5% fibers, 0.89% ash [12].

Regarding the nutritional profile of dried figs, *Muhammad Ajm al et al*., 2016 quotes *Khan et. al*., (2011) which evaluating the moisture content, ash and volatiles of dry fig indigenous to Pakistan that ranged from 12.89-17.50, 1.39-2.31 and 79.81–82.25% [24], respectively [14]. *Singh A. et al*., reported that 100 g edible part of dried figs contains: 23.0 g moisture, 4.3g protein 1.3g fat, 2.4 g minerals, 5.6g fiber, 69g carbohydrates, 200 mg calcium 77mg phosphorus, 4mg, iron, 100 IU vitamin A, 2mg vitamin C 2, 306 kcal and 0.1 mg thiamine [25, 38].

In a study of nutritional benefits and their health benefits, *M.I. Barolo et al*., 2014 [26] cite Vinson, JA, after which 100g dried figs contain 283 total calories, 0.52g total fat, 66.16g total carbohydrates, 12.21g total dietary fiber, 49.0g sugars, 3.14g protein, 9.76 IU Vitamin A and 0.68 mg Vitamin C [38].

Analyzing the proximate composition of dried figs, *Nareman S. Eshak* (2018) found that these fruits contain significant amounts of nutrients: 6.96% moisture (%), 7.45% protein, 5.69% ash, 0.98% raw fat, 8.92% raw fiber, 76.9% carbohydrate, 350.95 kcal / 100g energy and 93.04% total solids, - by sun dried, and 3.10% moisture, 8.42% protein), 7.30% ash, 1.20% crude fat, 9.21% crude fiber, 73.7% carbohydrate, 342.6 kcal / 100g energy and 94.90% total solids - by oven dried [20].

Analyzing the nutrient content of dried figs in Malaysia, *Muhammad Fawwaz Khairuddin et al*., 2017 found that they have a higher nutrient density compared to fresh ones: 30.86% moisture, 3.79% total ash, 3.93% raw protein, 4.02% crude fat, 57.36% total carbohydrate [27].

This study aims to evaluate the nutritional profile of some imported fig brands sold on markets in Timisoara, Romania. The following nutritional parameters were determined: moisture, total minerals (ash), crude protein, fats and total carbohydrate contents [36-38].

2. Materials and Method

In order to carry out the proposed experiment, samples of dried figs sold in different markets in Timisoara, from Mediterranean countries, were taken. Three sets of figs sold in polyethylene packaging of 200-500 g each were collected from five different locations. These sets were used to make samples for analysis, previously homogenized using a kitchen blender. The methods used to determine the nutritional parameters of the analyzed figs are methods validated and recommended by *Maria Rada et al*, 2020 and *Nik Nadira Nazua et al*, 2020 [13, 28]. The moisture content was determined by drying in an oven at 105°C until constant weight. The crude protein content was determined by the Kjedahl method; crude proteins were calculated as N × 6.25. The ash content was calcined in an oven at 600° C for 3 hours. The crude lipids (fats) were made by the method of extraction with petroleum ether using a Soxhlet apparatus. The crude fiber was extracted with 1.25% NaOH, drying the residue for one hour at 105° C followed by calcination at 600° C. The carbohydrate content was determined by calculation using the ratio [100 - (moisture + protein + fat + ash)].

2.1. Statistical analysis

The STATISTIC 10 package was used to perform the statistical analysis [29]. Descriptive statistics, Duncan's multiple test, and linear correlation analysis were performed. We calculated the mean and standard deviation for the analyzed nutritional parameters and we highlighted the statistical differences between the nutritional parameters of the figs from the 5 providers [30]. We observed relationships between the nutritional parameters of the analyzed figs and determined the Pearson linear correlation coefficients between these parameters.

3. Results and discussions

The results obtained from the analysis of dried figs taken in the experiment are presented in Table 1. The nutritional profile of dried figs (Table 1) shows beneficial effects of their consumption for health.

The distributions of carbohydrates, total fibers, proteins, minerals, fats, and moisture in dried figs analyzed in the fig samples studied (noted as P1, P2, P3, P4 and P5) are shown in Figure 1. The results obtained from the analysis of figs from five producers (P1, P2, P3, P4 and P5) show that dried figs contain increased amounts of carbohydrates, proteins, minerals, dietary fiber, dry matter and low fat content, which varies depending on the origin of the sample and the nature of the parameters analyzed. Statistical analysis showed that there were some statistically significant differences between the values of the nutritional parameters of the figs from five providers (Table 1 and Figure 1).

Carbohydrates, the major component of dried figs were determined in the range of 57.16% (P3) - 65.24% (P5). The highest value compared to the rest of the analyzed figs was determined in P5 figs (65.24%). Lower values but without statistically significant differences ($p < 0.05$) are reported in P1 (63.21%) and P2 (61.32%).

Table 1. Nutritional profile of dried figs (Ficus carica) from local market Timisoara city)

Specication	Moisture (%)	Proteine (%)	Fats (%)	Total fibers (%)	Minerals (%)	Carbohy-drate (%)
Provider 1.	24.72±1.05^{c,d}	3.24±0.33^{a,b}	0.90±0.20^{a}	9.82±0.70^{a}	2.36±0.27^{a,b}	63.21±2.39^{b,c}
Provider 2	25.84±01.32^{d}	3.12±0.38^{a,b}	1.12±0.19^{a}	9.11±0.5^{a}	1.93±0.30^{a}	61.32±2.41^{a,b,e}
Provider 3.	22.52±1.19^{b,c}	3.86±0.56^{b}	1.18±0.21^{a}	6.80±0.40^{c}	2.16±0.31^{a,b}	57.16±1.85^{a}
Provider 4.	19.68±1.24^{a}	3.25±0.31^{a,b}	0.83±0.13^{a}	4.35±0.34^{b}	2.75±0.33^{b}	59.55±2.19^{a,b}
Provider 5.	21.73±0.93^{a,b}	2.52±0.33^{a}	1.25±0.22^{a}	12.10±0.56^{d}	2.44±0.34^{a,b}	65.24±2.52^{c}
Mean values	***22.90±2.18***	***3.12±0.43***	***1.06±0.16***	***8.43±2.65***	***2.33±0.68***	***61.30±2.81***

Results given as mean ± standard deviation of triplicate analyses of three different samples. Different letters in the same column indicate a significant difference by Duncan test, at $p<0.05$) confidence level.

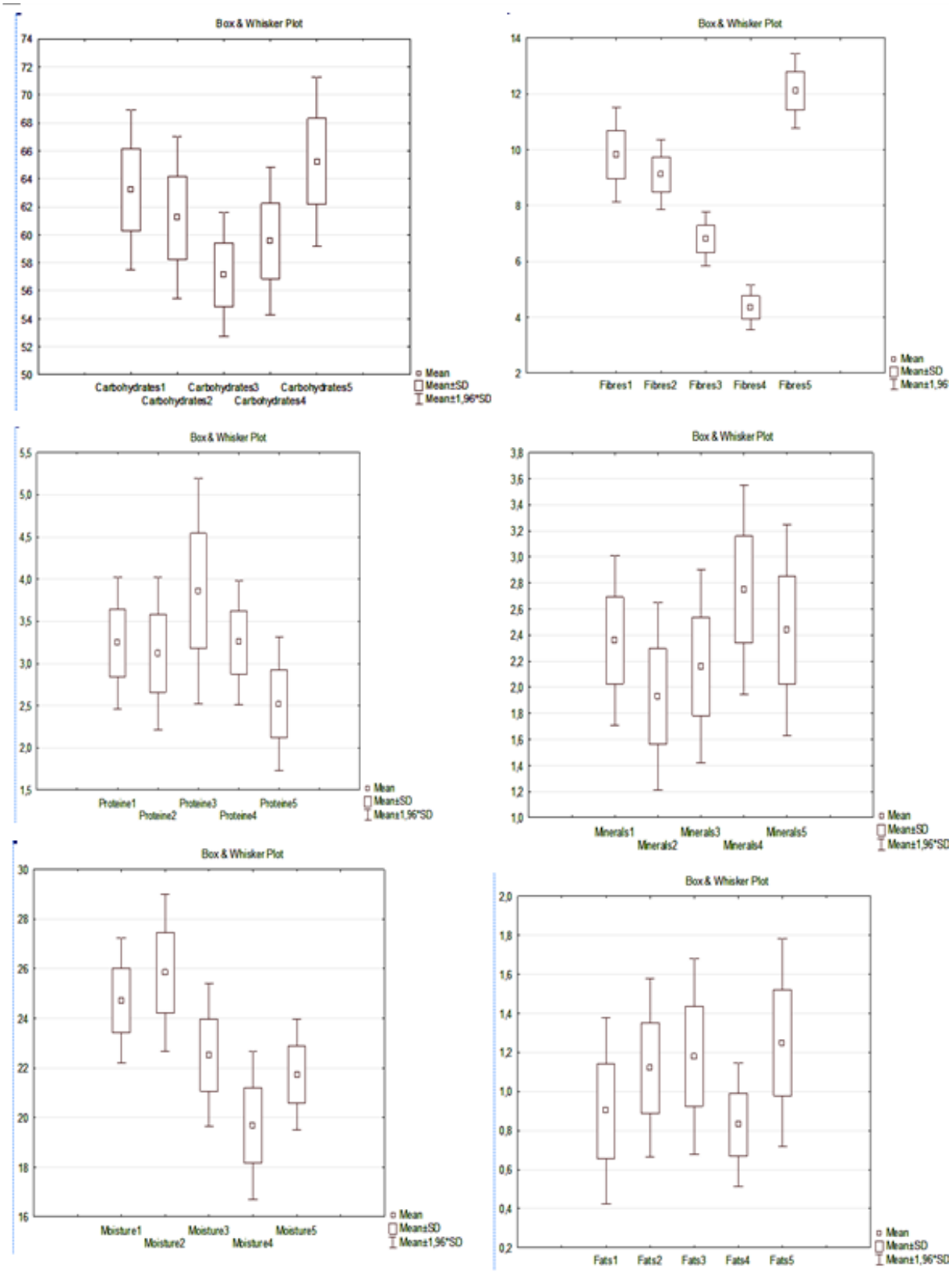

Figure 1. Box & Whisker Plot fordried figs P1-P5 analised

Table 2. The correlations between the studied parameters determined by the Pearson correlation (r, value).

	Correlations					
Variable	Moisture	Proteine	Fats	Fibres	Minerals	Carbohydrates
Moisture	1,000000	0,047571	0,201985	0,483335	**-0,845405**	0,189483
Proteine	0,047571	1,000000	-0,209640	**-0,667603**	-0,226568	**-0,905637**
Fats	0,201985	-0,209640	1,000000	**0,583407**	**-0,558026**	0,150305
Fibres	0,483335	**-0,667603**	**0,583407**	1,000000	-0,346279	**0,831336**
Minerals	**-0,845405**	-0,226568	**-0,558026**	-0,346279	1,000000	0,128309
Carbohydrates	0,189483	**-0,905637**	0,150305	**0,831336**	0,128309	1,000000

Lower contents, without statistically significant differences are observed in figs P4 (59.55%), respectively P3 (57.16%). Increased carbohydrate concentrations in the analyzed figs show that these fruits are suitable for diabetic and hypertensive patients who require low-sugar diets [31]. In addition, the high carbohydrate content of dried figs indicates that these fruits have a high nutritional value and are a good source of energy [20]. The average concentration of carbohydrates determined in P1-P5 figs (61.30±2.81%) is in the range of values reported by [2, 12, 8, 31].

Total fibers concentration, compounds that promote digestion and absorption in the small human intestine [32], was determined in the range of 4.35 (P4) -12.10% (P5). The richest in total fibers among figs are the P5 figs (12.10%) followed by the P1 and P2 figs which have very close fiber contents (9.82%, respectively 9.11%). Smaller amounts of fiber were determined in figs P4 and P3 (6.8% and 4.35%, respectively). These values show that the analyzed figs, especially the P5, P1 and P2 figs have high total fiber contents. The average concentration of total fibers (8.43±2.65%) falls within the range of values reported by [12, 20, 33, 36]. The statistical calculation ($p < 0.05$) reveals statistically significant differences between: P5 figs and P1 figs. P2, P3, P4. There are no statistically significant differences between P1 and P2 figs.

Proteins, important components of food, which provide adequate amounts of amino acids [17], were determined in relatively close concentrations between 2.52 (P5) - 3.86% (P3). The statistical calculation shows statistically significant differences ($p < 0.05$) only between P5 and P3 figs. These values show that figs P1, P2, P3 and P4 are more nutritionally favored, in terms of protein content.

The average concentration of proteins in P1 - P5 figs (3.12±0.43%) confirms that dried figs are good protein sources [12, 13, 14, 20, 27].

The mineral concentration (ash content), determined in the analyzed figs presents values in relatively close limits between 1.93% (P2) - 2.75% (P4). Slightly higher and closer values were identified in figs P4, P5 and P1 (2.75%, 2.44%, respectively 2.36%). Figs P3 and P2 have slightly lower contents, but close to minerals (2.16% and 1.93%, respectively). As the mineral concentration (ash concentration) reflects the content of mineral elements present in figs, it can be stated that, compared to other fruits, the dried figs analyzed have important contents of macro and essential microelements [13, 34]. The average value of mineral concentration calculated for P1-P5 figs (2.33±0.68%) is close to the values reported by [27, 33, 36], but slightly lower than those reported by [2, 20, 27, 31]. Statistically, from the mineral content point of view, no significant differences ($p < 0.05$) were reported between figs P1, P3, P5 and between figs P4, P5. Significant differences were reported between the mineral concentration of P2 and P4 figs.

Fats were determined in small and very small quantities, the concentration limits being very close: 0.83 (P4) - 1.25% (P5%). The data obtained from the statistical calculation do not show statistically significant differences (<0.05) between the fat concentrations in the analyzed figs. The low lipid content favors the consumption of figs for weight loss [13]. The average values of fat content for P1-P5 figs (1.06±0.16%) confirm that these fruits contain low amounts of fat and [12, 20, 33], which shows possible hypolipidemic effects of these fruits [31].

Humidity, an important parameter for fig preservation, was determined in concentration limits between 19.68 (P4) - 25.84% (P2). The highest values were determined in figs P2 and P1, followed by figs P4, P5 and P3. The lower water content of the fruit slows down the process of microorganism degradation and chemical changes [4]. Therefore, the low moisture content prolongs the shelf life of the fruit. From this point of view, P4 and P5 figs are favored. The average value of P1-P5 fig moisture (22.90±2.18%) is close to the values reported by *Vincenzo Lo Turco et al*., 2020 [35] and less than the maximum moisture value allowed for retail sale (24%) without the use of a mold inhibitor [22]. No statistically significant differences ($p < 0.05$) were reported between figs P1 and P3, P1 and P2, P3 and P5, respectively P4 and P5. We report statistically significant differences between P4 and P1, P4 and P3. Statistical analyses (Table 2), for $p < 0.05$, reveals the significant negative correlations between proteines and carbohydrates ($r = -0.91$) and between moisture and minerals ($r = -0.85$) and significant pozitive correlations between the fibre and carbohydrates ($r = 0.83$). The correlation between other parameters was less stronreg: negative correlation between proteines and fibres ($r = -0.67$) and betwen fats and minerals ($r = -0.56$), and positive correlation between fats and fibres ($r = 0.58$).

Therefore, increasing carbohydrate concentrations favors (significantly) increasing the fiber content and decreasing the protein content. Also, the increase of humidity influences (significantly) the decrease of the mineral content. In addition, with the increase of the fat content, the mineral content decreases (moderately) and the fiber concentration increases (moderately). Increasing the protein content has the effect of decreasing (moderately) the concentration of fiber.

4.Conclusion

The nutritional profile of the dried figs taken in the analysis shows that these fruits contain significant amounts of nutritional components potentially beneficial to health. Carbohydrates, the major component of dried figs were determined in an average concentration of 61.30%, which indicates that they are a good source of energy for the metabolic and physiological process of the body. Also, these fruits contain high amounts of fiber (on average 8.43% soluble and insoluble) that has a number of health benefits.

Furthermore, dried figs contain significant amounts of protein (3.12%, mean value) and minerals (on average 2.33% ash) which shows that they are good sources of amino acids and mineral elements, essential components for the hunan body. Dried fig fruit has a very low amount of fat (1.06%, mean value) so it can be helpful for weight loss. Moisture, a parameter that characterizes the shelf life (stability) of dried figs has an average value of 22.90%, and less than the maximum moisture value allowed for retail sale without the use of an inhibitory mold. Statistical analysis ($p < 0.05$) reveals significant and moderate correlations between the analyzed nutritional parameters. Experimental results show that the studied dried figs are an excellent source of carbohydrates and mineral fibers, good sources of protein and minerals and contain low amounts of fats.

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