

SOME CHEMICAL, NUTRITIONAL AND MINERAL PROPERTIES OF DRIED JUNIPER (*JUNIPERUS DRUPACEA* L.) BERRIES GROWING IN TURKEY

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Abstract. Berries of *Juniperus drupacea* L. are important non-wood product used in traditional pekmez (fruit concentrate) production in Turkey. In this article, some chemical, nutritional and mineral properties of dried mature *J. drupacea* berries are reported. The materials were collected from Kahramanmaraş and Adana Provinces (Turkey). The results are given in the order of Kahramanmaraş and Adana; total dry matter 92.89 and 93.30%, water soluble dry matter 62.40 and 57.07%, protein 2.06 and 3.74%, lipid 5.49 and 3.84 g/100g, pH 5.53 and 5.65, titratable acidity 0.38 and 0.52%, K 14.5 and 17.3 g/kg, Ca 890.5 and 794.7 mg/kg, Na 67.0 and 68.1 mg/kg, Mg 439.2 and 543.6 mg/kg, Fe 33.8 and 65.8 mg/kg, Cu 4.4 and 5.5 mg/kg, Zn 16.5 and 18.1 mg/kg and finally Mn 4.7 and 5.1 mg/kg. In addition, holocellulose (carbohydrate) was determined as 14.29 and 16.01%, lignin (phenolic compounds) as 16.94 and 18.98% and ash (inorganic constituents) content as 4.00 and 3.38%. The soluble content of toluen/acetone/ethyl alcohol, hot water and cold water for Kahramanmaraş samples were 31.18, 67.08 and 60.74%. They were 37.56, 63.36 and 55.81% for specimens from Adana. The berries from Kahramanmaraş showed higher lipid, soluble solid, Ca and ash contents than those from Adana.

Keywords: *Syrian juniper, refractometer, protein, lipid, functional foods*

Introduction

One of the juniper species in Turkey is *J. drupacea* which naturally grows in Mediterranean countries such as Turkey, Syria, Lebanon and Greece. Within this general distribution area, in the mountainous parts of the Eastern and Central Mediterranean regions of Turkey, it has a significant distribution between 600 and 1750 m altitude (Gültekin, 2014). It covers 958.423 ha which is 4.29% of the total forest area of country (OGM, 2015).

In Turkey, from the fruits of *J. drupacea* “pekmez” (fruit concentrate) is produced traditionally by the local people and used to treat asthma and bronchitis. It is an important foodstuff for people with high energy needs, mainly consumed in the winter months (Seca et al., 2015; Güneş et al., 2017).

Functional nutritional science has been very important nowadays. As average life expectation and healthcare costs rise, the people has investigated to become healthier and improve the quality of life. Functional foods may be “an essential macronutrient, or an essential micronutrient. While a macronutrient (e.g. carbohydrates, fats, and proteins) must be ingested in large amounts in human diet, a micronutrient (e.g. vitamins or minerals) must be consumed in certain trace amounts. Bioactive compounds are considered as the source of functional food effectiveness. Bioactive compounds can be categorized as “phenolic compounds, proteins, peptides and lipids, and carbohydrates (Martirosyan and Singh, 2015).

Leaves, fruits, seeds and wood parts of junipers contain considerable chemical components. So, it takes important places in medicine, pharmacology and food industry. Juniper species are very miscellaneous and have been subject of researches by many scientists for its oil, protein, reduced sugar, mineral, essential oil, phenolic compound content and antioxidant - antimicrobial activity properties (Nasri et al., 2011; Jalal et al., 2014; Hosseinihashemi, 2017; Salamon et al., 2017; Miceli et al., 2018).

Although there are many works about *J. drupacea* fruit concentrate (Özdemir et al., 2004; Akıncı et al., 2004; Kocakulak, 2007; İzgi, 2011), less studies related to its dried fruit physical, chemical and mineral features are provided with. In the present study, some chemical (holocellulose, lignin, toluene-acetone-ethyl alcohol solubility, hot-cold water solubility and ash content), nutritional (total dry matter, water soluble dry matter, protein, lipid, pH, titratable acidity) and mineral (K, Ca, Na, Mg, Fe, Cu, Zn ve Mn) components of dried mature fruit are identified.

Materials and methods

Materials

In this study, mature ripe juniper berries obtained from Kahramanmaraş-Andırın (KM) and Adana-Kozan (AA) in Eastern Mediterranean Region were used as experimental materials (*Figure 1*). The samples were collected in 2014, February-March and the information related to the places samples taken are given in *Table 1* and *Figure 2*. Thirty berries were collected from each of the 30 randomly selected trees and a total of 900 berries were collected in each province. The collected samples were then dried in the laboratory environment under open air conditions. The dried samples were broken and seeds removed, later the remaining parts were grinded in the Willey-mill, sieved and preserved in glass jars.

Methods

The methods used to identify the main chemical components of the juniper berry: Holocellulose, lignin and ash content was determined according to Wise's chlorite method (Wise and Karl, 1962), TAPPI T222om-02 (2002) and TAPPI T211om-02 (2002) standards, respectively. Solubility properties, including toluene-acetone-ethyl alcohol (4:1:1, w/w) and cold - hot water solubilities were determined according to TAPPI T204cm-97 (1997) and TAPPI T207cm-99 (1999), respectively.

Methods for determining nutritional properties of *J. drupacea* berries are: Total dry matter was determined by drying the samples to a constant weight in a 65°C oven (AOAC, 1990). Soluble solid and pH values of the extract from the berries were determined by using a Hanna HI96801 refractometer and a pH meter (IFJU, 1968a, 1968b). Protein was calculated from the percentage of nitrogen found by using the Kjeldahl method (TS4895 EN ISO3188). Lipid content and titratable acidity of the samples were determined by the soxhlet extraction method, with hexane (AOAC, 1984) and by the titration method with, 0.1 N NaOH (IFJU, 1968c), respectively. All chemical analysis results were calculated relative to oven dry sample weight.

To determine the mineral components of juniper berry the samples were burned with HNO₃ (65%) and H₂O₂ (35%) solution in a microwave. Then, the absorbance of the extract was determined with the Atomic Absorbance Spectrophotometer, Perkin Elmer

Optima 2100DV ICP-OES coupled with AS93 auto sampler. The mineral content was calculated with a standard curve.

To evaluate the significant differences between the mean values of each of the properties, independent-samples t-test analyses (ISTTA) were used. All statistical analyses were conducted by means of SPSS Statistics software, and the results were considered significant at $p \leq 0.05$.



Figure 1. *Juniperus drupacea* tree, leaf and fruit (Kocakulak, 2007)

Table 1. Information for locations where juniper berries collected

Location	Latitude	Longitude	Altitude (m)
Kahramanmaraş-Andırın	37°45'	36°42'	943
Adana-Kozan	37°38'	35°50'	895

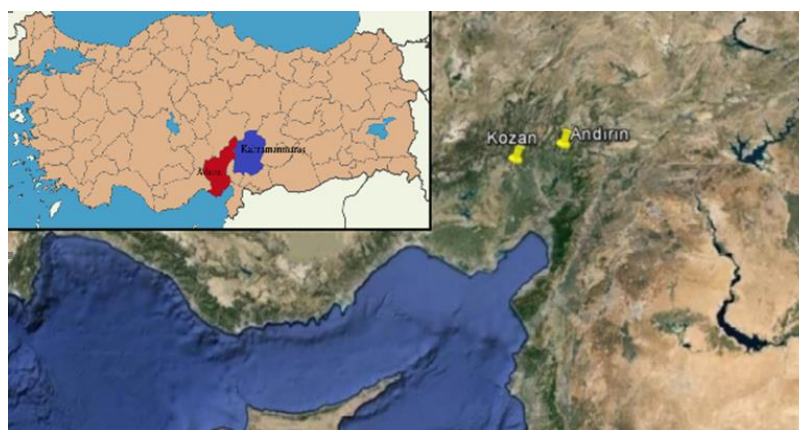


Figure 2. Geographical location of the study area in Turkey

Results and discussion

The main chemical, nutritional and mineral composition of *J. drupacea* dried berries are shown in *Tables 1, 2 and 3*, respectively. In order to compare the provided results, the properties of juniper berries from Akseki-Antalya (AY) from Western Mediterranean Region are also shown in *Table 2* and *Table 3*. In addition to these, related properties of carob bean and raisins are given in the same tables, respectively.

Table 2. Dried *J. drupacea* berries' main chemical components and their ratios

Component (%)	Determination			Literature	
	KM berries	AA berries	Mean	Softwoods (Kırcı, 2006)	Hardwoods (Kırcı, 2006)
Holocellulose	14.29 (0.38) b	16.01 (0.31) a	15.15	63 - 70	72 - 82
Lignin	16.94 (0.40) b	18.98 (0.33) a	17.96	25 - 32	18 - 26
Toluene/acetone/alcohol solubility	31.18 (0.32) b	37.56 (0.45) a	34.37	1 - 5.8	1 - 6.2
Hot water solubility	67.08 (0.14) a	63.36 (0.37) b	65.22	1 - 5	1 - 8
Cold water solubility	60.74 (0.26) a	55.81 (0.41) b	58.28	0.5 - 4	0.2 - 4
Ash	4.00 (0.25) a	3.38 (0.05) b	3.69	0.2 - 0.5	0.2 - 0.7

*KM= Kahramanmaraş, AA= Adana, AY= Antalya

**Values given in parentheses indicate (\pm) standard deviations

***Different letters in the same line represent statistical differences at the 95% confidence level

Table 3. Nutritional properties of *J. drupacea* dried berries

Content	Determination			Literature	
	KM berries	AA berries	Mean	AY Berries (Akıncı et al., 2004)	Carob bean (Karcier and Artık, 1995)
Total dry matter (%)	92.89 (0.11) b	93.30 (0.00) a	93.10	76.57	91.60
Soluble solid (%)	62.40 (0.11) a	57.07 (0.09) b	59.74	33.68	64.68
Protein (%)	2.06 (0.04) b	3.74 (0.03) a	2.90	2.45	4.05
Lipid (%)	5.49 (0.09) a	3.84 (0.03) b	4.67	4.28	-
pH	5.53 (0.03) b	5.65 (0.00) a	5.59	5.77	5.53
Titretable acidity (% , SSA)	0.38 (0.02) b	0.52 (0.01) a	0.45	-	0.72

*KM: Kahramanmaraş, AA: Adana, AY: Antalya

**Values given in parentheses indicate (\pm) standard deviations

***Different letters in the same line represent statistical differences at the 95% confidence level

Chemical and nutritional properties of *J. drupacea* dried berries

The major chemical components of natural lignocellulosic materials are holocellulose (total carbohydrate), lignin (phenolic compounds), ash (total inorganic constituents) and a very small fraction of so-called extractives (Fengel and Wegener, 1989; Chen, 2014). All these substances have an important place in human nutrition.

The average results and standard deviations of main chemical components of juniper berry from KM and AA are given in *Table 2*, the results of nutritional properties are given in *Table 3*. Juniper berry is a hard nut and cannot be consumed as a fresh fruit. So, general chemical properties of main components for softwoods and hardwoods are also given in *Table 2*.

As indicated in *Table 2*, the holocellulose mean ratio for juniper berry is 15.15% and this value is quite less than that in both softwood and hardwoods. With regard to lignin amount juniper samples (17.96%), it showed hardwood characteristics. Phenolic substances have important contributions to human health. These compounds have been reported to play an effective role in preventing cancer and cardiovascular diseases by preventing free radical formation in the body (Gil et al., 2000). The results also showed that fruits from AA junipers have more lignin (18.98%), in other words, more phenolic compounds than those from KM (16.94%).

It is possible to remove waxes, oils, resins, photosterols, non-volatile hydrocarbons, low molecular weight carbohydrates, salts and other water soluble components present

in the sample with neutral organic solvents (TAPPI T204cm-97, 1997). According to the results obtained, the solubility content of toluene/acetone/ ethyl alcohol (34.37%) and the hot water (65.22%) - cold water (58.28%) of the samples were found to be fairly high when compared to softwood and hardwoods.

The ash content of juniper berry samples was determined as 3.69%. This value found to be 2.51 g/100g for Antalya samples, 2.40% for raisins and 2.5% for carob bean (Karkacier and Artık, 1995; Akıncı et al., 2004; Kalkan et al., 2012). According to all these values, the amount of ash in KM and AA junipers berry found to be rather high.

When nutritional property mean values in *Table 3* compared, soluble solid content was 62.40% for the berries from KM and 57.07% for AA samples. This value has been reported as 33.68% for AY juniper berry and 64.68% for carob bean (Karkacier and Artık, 1995; Akıncı et al., 2004). The highness of this value is desirable. Accordingly, KM and AA soluble dry matter is 77.4% higher than AY specimen, and shows similarity to that from carob fruit.

Considering *Table 3*, the protein (3.74%), pH (5.65) and titratable acidity (0.52%) values of AA samples were higher than those for samples from KM as 2.06%, 5.53 and 0.38%, respectively. The lipid amount of KM samples was found to be 43% higher than that from AA. According to data from literature survey, the value for protein was found as: AY juniper berries 2.45%, *J. communis* L. berries 4.28% and carob bean 4.05% (Karcier and Artık, 1995; Akıncı et al., 2004; Bacém, 2018). According to results from the present work, titratable acidity value for juniper berries (0.45%SSA) is more acidic than carob bean (0.72%SSA).

Mineral composition of *J. drupacea* dried berries

Minerals have important place in human nutrition. The importance of these minerals, also known as trace elements, has been well understood in recent years, since when missed, causes diseases and major disorders in the human body (Bittencourt, 2018).

Mineral content and their ratio in KM and AA juniper berries are given in *Table 4*.

Table 4. Mineral composition of *J. drupacea* dried berries

Mineral composition	Determination			Literature	
	KM berries	AA berries	Mean	AY berries (Akıncı et al., 2004)	Raisins (Kalkan et al., 2012)
K (g/kg)	14.5 (b)	17.3 (a)	15.9	10.0	7.5
Ca (mg/kg)	890.5 (a)	794.7 (b)	842.6	1063.0	500.0
Na (mg/kg)	67.0 (b)	68.1 (a)	67.6	84.8	20.0
Mg (mg/kg)	439.2 (b)	543.6 (a)	491.4	477.0	70.0
Fe (mg/kg)	33.8 (b)	65.8 (a)	49.8	15.4	18.8
Cu (mg/kg)	4.4 (b)	5.5 (a)	4.95	29.2	3.2
Zn (mg/kg)	16.5 (b)	18.1 (a)	17.3	13.9	2.2
Mn (mg/kg)	4.7 (b)	5.1 (a)	4.9	9.0	-

*KM: Kahramanmaraş, AA: Adana, AY: Antalya

**Letters in parentheses represent statistical differences at the 95% confidence level

Results showed that the amount of K (17.3 g/kg), Na (68.1 mg/kg), Mg (543.6 mg/kg), Fe (65.8 mg/kg), Cu (5.5 mg/kg), Zn (18.1 mg/kg) ve Mn (5.1 mg/kg) from AA are higher than those in KM samples. In contrast, only the amount of Ca (890.5 mg/kg) in KM berries is higher than that in AA (794.7 mg/kg).

When the mean values of the results considered, KM and AA berries contain more K, Mg, Fe and Zn than AY berries and raisins. Inci et al. (2016) reported that *Juniperus communis* berries contained 61.2 g/kg K, 1.90 mg/kg Mg, 80.12 mg/kg Fe, 15.31 mg/kg Mn, 18.80 mg/kg Zn and 19.94 mg/kg Cu. When we compared berries of *J. drupacea* and *J. communis*, it is seen that *J. communis* berries has a higher mineral content.

Conclusion

When the data obtained within the scope of the study considered, it can be mentioned that juniper berries collected from Kahramanmaraş Province, found to be more oily, with more soluble solids, extractive matter (hot and cold water solubility), ash and calcium content than those from Adana Province samples. However, dried berries from Adana Province contains more holocellulose, lignin, protein and mineral matters (K, Na, Mg, Fe, Cu, Zn, Mn).

When the data obtained within the scope of the study considered, it can be mentioned that juniper berry is a good source of minerals. It contains especially a fine ratio of Fe.

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