

Some Physico-Chemical and Nutritional Properties of ‘Musmula’ Medlar (*Mespilus germanica* L.) Grown in Northeast Anatolia

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Abstract—In this study, The physico-chemical and nutritional properties of ‘Musmula’ Medlar (*Mespilus germanica* L.) fruit and seed grown in Northeast Anatolia was investigated. In the fruit, length, width, thickness, weight, total soluble solids, colour (1), colour (2) [L, a, b values], protein, crude ash, crude fiber, crude oil, texture and pH were determined as 4.34 cm, 4.22 cm, 3.67 cm, 38.36 g, 23.97 %, $S_{60}O_{60}Y_{41}$, [53.85, 17.15, 33.75], 1.06 %, 0.79 %, 4.24 %, 0.005 %, 1.21 kg/cm² and 4.26 respectively. Also, pulp ratio, seed ratio and pulp/seed ratio were found to be 92.88 %, 7.11 % and 14.07 %, respectively. In addition, the mineral composition of medlar fruit in Northeast Anatolia was studied. In the fruit, 23 minerals were analyzed and 19 minerals were present at detectable levels. The medlar fruit was richest in potassium (6962 ppm), calcium (1186.378 ppm), magnesium (1070.08 ppm) and phosphor (763.425 ppm).

Keywords—Fruits, *Mespilus germanica* L., mineral compounds, physico-chemical properties.

I. INTRODUCTION

TURKEY (Anatolia) is a very important area for plant diversity. Many fruit species are grown and many different local or native fruit species and varieties are known. One of these called ‘Musmula’ is Medlar (*Mespilus germanica* L.). Musmula originated in North Anatolia, Southeastern Europe and Iran [1]. The native form of medlar, at least in North Anatolia, open forest, on rocks and in macchie, is also widely cultivated [2]. Musmula is belongs to *Rosaceae* family. Spiny shrub of the medlar is 2–3 m high (in cultivation a spineless tree up to 6 m). Medlar has elongated leaves and the leaves and flowers are similar to that of apple. Medlar plants have been long-cultivated for their edible fruits. The fruits of medlar are subglobose, 1.5–3 cm. The cultivated plants have larger and sweeter fruits compared to the wild forms. Medlar fruits are large, 5 cm across, and brown when ready to eat. The central cavity is filled with flat, circular, yellowish or brown seeds 3/8–1/2 in. (1–1.25 cm) long, enclosed in grayish yellow, mucilaginous membranes arranged in rows around a central fleshy core [3].

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Recently, the physical (weight, colour, firmness), physico chemical (pH, soluble solids) and chemical (moisture, soluble sugars, starch) changes during maturation of Spanish medlar have been reported [4]. More recently, changes in mineral composition, at different stages of maturity of medlar [5] and fatty acid composition, during ripening of medlar [6] have been reported. Baytop [1] reported that the fruit is rich in sugar, organic acids and tannins. De Pascual et al. [7] analyzed flavanols in medlar fruit. Besides these studies, data on the composition and nutritional value of medlars are still scarce [8]. As far as we know, there are not enough studies on the chemical and nutritional composition of the medlar fruits [9]. The aim of this study was to determine some physical, chemical and nutritional properties of ‘Musmula’ Medlar.

II. MATERIALS AND METHODS

A. Materials

‘Musmula’ Medlar fruits were used for all experiment in this study. Medlar trees grow wild in various regions (especially in North and West-Anatolia and Marmara regions) of Anatolia (Turkey) [8]. Fruits were randomly collected from medlar tree which were 1.5 m tall; their trunk 5 cm thick; were 3 years old and had 1.5 m canopy diameter. 20 fruits of each treatment were used for analyses.

B. Methods

1. Determination of Size

From the samples, 20 fruits were selected at random for determining the physical characteristics. For each fruit and seed, 3 linear dimensions were measured, that is (a) length, (b) width and (c) thickness, using a vernier caliper reading to 0.01 mm. Hence measurement of all size indices was replicated 10 times for medlar fruit. The weight of individual fruit and seed for medlar were determined by using an electronic balance to an accuracy of 0.001 g. Each measurement was replicated 20 times.

2. Pulp Ratio

The remaining pulp ratio percentage were calculated [10]. Pulp Ratio (%): $\text{Fruit Weight} - \text{Seed Weight} \times 100 / \text{Fruit Weight}$

3. Seed Ratio

The equation used is as follows for Seed Ratio(%) [10].
Seed Ratio (%): Fruit Weight – Pulp Weight x 100/ Fruit Weight.

4. Pulp/Seed Ratio

The equation used is as follows for Pulp/Seed Ratio (%) [10]. Pulp/Seed Ratio (%): Pulp Ratio (%) / Seed Ratio (%).

5. Total Soluble Solids

The content of total soluble solids was determined using samples of fruit pulp with a hand refracto meter, at room temperature (range from 18 to 23 °C) [11].

6. Colour (1)

The colour scale was employed for determination of the fruit juice colour [12].

7. Colour (2)

The colours of medlar fruit were measured using Hunter *L* (brightness: 100, white; 0, black), *a* (+, red; -, green) and *b* (+, yellow; -, blue) parameters with a colorimeter (model CR 400 chromometer, Konika Minolta Sensing, Inc., Osaka, Japan) [13].

8. Texture

For texture measurements, the medlar fruits were peeled (very thin layer) in 2 different places in the equatorial region of the medlar fruit. The texture was measured in a handle penetrometer with cross heads of 0.8 cm of diameter. Texture was expressed by kg/cm².

9. pH

10 g of samples were homogenized for pH measurements. A digital pH meter was employed at 25°C [14].

10. Protein

The nitrogen content estimated by the Kjeldahl method and was converted to protein content by using the conversion factor 6.25 [15].

11. Crude Ash

Crude ash was determined in a muffle furnace at 850 °C for 8 h [16].

12. Crude Fiber

Crude fibre was determined in the sample using the standard methods of analysis of the [16].

13. Crude Oil

Samples were homogenized and subjected to extraction for 6 h with petroleum ether (boiling range 30–60 °C) in a Soxhlet apparatus. The extracted oil was dried over anhydrous sodium sulphate and the solvent was removed under reduced pressure in a rotary film evaporator. Oil percentages were determined by weight difference [16].

14. Determination of Mineral Contents

About 0.5 g dried and ground sample was put into burning cup and 10 ml pure HNO₃ was added. The sample was incinerated in MARS5 microwave oven under the 170 psi at

200 °C temperature and solution diluted to the certain volume (25 ml) with water. Samples were filtered in filter paper and were determined with an ICP-AES [17].

15. Working conditions of ICP-AES

Instrument: ICP-AES (Varian-Vista; Australia)

RF power: 0.7 - 1.5 kW (1.2 - 1.3 kW for axial)

Plasma gas flow rate (Ar): 10.5 - 15 L/min (radial), 15 L/min (axial)

Auxiliary gas flow rate (Ar): 1.5 L/min

Viewing height: 5 - 12 mm

Copy and reading time: 1 - 5 s (max. 60 s)

Copy time: 3 s (max. 100 s)

III. RESULTS AND DISCUSSION

Some physico-chemical and nutritional characteristics of 'Musmula' Medlar were given in Table I, II and III.

TABLE I
SOME PHYSICAL CHARACTERISTICS OF "MUSMULA" MEDLAR

Traits	Mean	Traits	Mean
Fruit weight (g)	38.36	Fruit length (cm)	4.34
Seed weight (g)	3.21	Fruit width (cm)	4.22
Pulp ratio (%)	92.88	Fruit thickness (cm)	3.67
Seed ratio (%)	7.11	Seed length (mm)	11.43
Pulp/seed ratio (%)	14.07	Seed width (mm)	7.9
Texture (kg/cm ²)	1.21	Seed thickness (mm)	4.73

TABLE II
SOME CHEMICAL CHARACTERISTICS OF "MUSMULA" MEDLAR

Traits	Mean
Total Soluble Solids (%)	23.97
pH	4.26
Colour (1)	S60O60Y41
Colour (2)	L=53.85 a=17.15 b=33.75
Protein (%)	1.06
Crude Ash (%)	0.79
Crude Fiber (%)	4.24
Crude Oil (%)	0.005

The medlar fruit mean length, width, thickness, weight, texture pulp ratio, seed ratio and pulp/seed ratio were found to be 4.34 cm, 4.22 cm, 3.67 cm, 38.36 g, 1.21 kg/cm², 92.88%, 7.11% and 14.07%, respectively. The seed of fruit mean length, width, thickness and weight were found to be 11.434 mm, 7.9 mm, 4.73 mm, and 3.21 g, respectively (Table I). Haciseferogullari et al. [3] reported fruit weight was 11.98 g in Isparta (located in South Anatolia). This difference were probably due to environmental conditions and/or different variety. In our study, total soluble solids, colour (1), colour (2) [L, a, b values], protein, crude ash, crude fiber, crude oil, and pH were determined as 23.97 %, S₆₀O₆₀Y₄₁, [53.85, 17.15, 33.75], 1.06 %, 0.79 %, 4.24 %, 0.005 %, and 4.26

respectively (Table II). Eksi [18] reported that cornelian fruit contained 13.2–15.5% total soluble solids, 0.15–0.18% protein, 5100–7400 mg/kg ash. Also, rose (*Rosa canina*) fruits contained 21.50% total soluble solids, 4.36 pH, 9.67% protein and 3.03% fiber [11]. Haciseferogullari et al. [3] reported that medlar fruit contained 68.89 % total soluble solids, 3.71% protein, 11.4% fiber, 1.96% ash and 4.26 pH. While we found fiber of medlar fruits to be high, protein and total soluble solids was found low according to Haciseferogullari et al. [3]'s results. Limited studies on medlar fruits have been performed hitherto. Glew et al. [8] reported that this type of information could provide local populations (where medlar is a native species in their flora) with a basis for food choices.

TABLE III
SOME NUTRITIONAL CHARACTERISTICS OF "MUSMULA" MEDLAR

Parameters	Values (ppm)	Parameters	Values (ppm)	Parameters	Values (ppm)
K	6962.6441	Fe	5.983	Li	0.301
P	763.425	Cr	0.241	Sr	5.802
Ca	1186.378	Zn	1.087	Al	4.515
Na	82.800	Cu	0.496	Ni	0.593
Mg	1070.08	V	3.200	As	0.068
S	131.238	B	7.959		
Pb	0.133	Cd	0.018		

The mineral content of medlar fruit was determined by ICP-AES (Table II). Potassium (6962.6441ppm) was present in the highest concentration, followed by Ca (1186.378ppm), Mg(1070.08ppm), P (763.425ppm), Na, S and B were present in higher amounts, and Pb, Fe, Zn, Cu, Cd, Li, Sr, Al, Ni, As, V and Cr were also detected. Haciseferogullari et al. [3], reported that Potassium (8052.91 mg/kg) was present in the highest concentration, followed by S (3544.6 ppm), Ca (883.0 ppm), B (356.5 ppm) and P (344.8 ppm). K, Ca, B and S were present in higher amounts, and traces of Cr, Ti and V were also detected. In our results, while P, Al, B, Ca, V were found to be high, Cr, Fe, K, Pb and S, was found to be low in accord with Haciseferogullari et al [3]'s literature values. Glew et al. [5] reported that the ripe medlar fruit is an important source of nutritionally needed minerals and trace elements. Also the same researchers reported that they analyzed 16 minerals (Al, Ba, Ca, Cu, Co, Fe, K, Li, Mg, Mn, Na, Ni, P, Sr, Ti and Zn) of medlar fruit, and showed their richness in potassium (7370 lg/g dry wt), calcium (1780 lg/g dry wt), phosphorus (1080 l g/g dry wt), magnesium (16611 g/g dry wt) and sodium (1831 g/g dry wt). The results presented in our work showed that 'Musmula' Medlar fruits are important in our diet as a mineral resource.

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