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# XURMO O‘SIMLIGI (DIOSPYROS KAKI) TARKIBIDAGI MAKRO VA MIKROELEMENTLARINI ZAMONAVIY INDUKTIV-BOG‘LANGAN PLAZMALI MASS-SPEKTROMETRIYA USULI BILAN ANIQLASH

# ОПРЕДЕЛЕНИЕ МАКРО- И МИКРОЭЛЕМЕНТОВ В ХУРМЕ ВОСТОЧНОЙ (*DIOSPYROS KAKI)* СОВРЕМЕННЫМ МЕТОДОМ МАСС-СПЕКТРОМЕТРИИ С ИНДУКТИВНО-СВЯЗАННОЙ ПЛАЗМОЙ

# DETERMINATION OF MACRO AND MICRO ELEMENTS IN THE DATE PLANT DIOSPYROS *KAKI* BY THE MODERN METHOD OF MASS-SPECTROMETRY WITH INDUCTIVELY COUPLED PLASMA

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***Annotatsiya***

*Xurmo o‘simligini bargi va mevasi namunalarining elementlar tarkibi birinchi marta batafsil ICP-MS AT 7500 uskunasida induktiv bog‘langan plazma mass-spektrometriya usulida o‘rganildi. Xurmo o‘simligini bargi va mevasi tarkibida 42 ta element miqdoriy aniqlandi. O‘simlik bargida 39 element “Shokolad”navli xurmo mevasida 40 element, “Limon” xurmo mevasida 39 element borligi ko‘zatildi. Element miqdori uning massasi ortishi bilan kamayishining tabiiy tendensiyasi ko‘rsatilgan. Xurmo (Diospyros) o‘simligini mevasi tarkibidagi og‘ir elemetlar miqdori juda oz miqdorda ekanligi kuzatildi.*

***Аннотация***

*Элементный состав образцов листьев и плодов растения Хурма восточная детально изучен впервые методом масс-спектрометрии с индуктивно-связанной плазмой на приборе ICP-MS AT 7500. В листьях и плодах хурмы количественно определено 42 элемента. Было обнаружено, что в листьях растения содержится 39 элементов, в плодах сорта “шоколад”-40 элементов, а в плодах сорта “лимонный”(с вяжущим вкусом) - 39 элементов. Показана естественная тенденция количества элемента уменьшаться с увеличением массы. Было замечено, что количество тяжелых элементов в плодах растения очень мало.*

***Abstract***

*The element composition of persimmon leaves and fruits samples for the first time was studied in detail by mass spectrometry with inductively coupled plasma on ICP-MS AT 7500. A total of 42 elements were quantified in persimmon leaves and fruits. It was found that 39 elements were present in the leaves, 40 elements in the “chocolate” variety fruits and 39 elements in the lemon variety fruits (with astringent taste). The natural tendency of the amount of the element to decrease with increasing mass is shown. It has been observed that the amount of heavy elements in the fruits of the date plant is very low.*

***Kalit so‘zlar:*** *Diospyros, makroelementlar, mikroelementlar, mass- spektrometriya, IBP MS, Agilent Technologist.*

***Ключевые слова:*** *Diospyros, макроэлементы, микроэлементы, масс-спектрометрия, ИСП МС, Agilent Technologist.*

***Key words:*** *Diospyros, macroelements, microelements, mass-spectrometry, ICP MS, Agilent Technologist.*

## INTRODUCTION

Persimmon (Diospyros) is a subtropical tree or shrub belonging to the persimmon family. Native fruit tree. About 500 species are found in tropical and subtropical regions. The palm tree is planted in China, Japan, Mediterranean countries, Australia, USA, Caucasus, Central Asia and Uzbekistan. The height of the tree is up to 8-12 m, the trunk is round or pyramidal [1]. It lives 100-400 years, sometimes even more, but it bears good fruit up to 50-60 years. It tolerates cold up to 15-20°C, it is a light-loving plant. The leaf is large ovate, dark green on top, hairy on the back, arranged in a row, turns reddish before shedding [2].

Scientific [3] and summary [4] articles devoted to the study of the chemical composition of persimmons have been covered in detail by Spanish and Portuguese scientists. In particular [3], the authors studied three types of dates and obtained excellent results. According to their information, the amount of macro- and microelements in this plant may change slightly seasonally. Iron 1.5-2.3 mg/kg, copper 2.6-2.8 mg/kg, zinc 1.1-6.9 mg/kg in the 2017 season. Calcium 150-366mg/kg, Magnesium 136-209mg/kg from macroelements. Potassium 2512-3491 mg/kg. It should be noted that the differences in quantity are very large. However, in the 2018 season, it was found that the differences were not so big. In fact, the mineral components of the plant are mainly related to the soil composition. Perhaps a lesser contribution can be made by the ability of the plant to assimilate salts. But these two factors are the same. For other reasons, the amount of water can change the ratio of components, as scientists have analyzed wet fruit.

## MATERIAL AND METHODS

Determination of mineral content. The fruit of the date tree was collected for the sample from the region of Baghdad district of Fergana region. In the fall, the fruits of the plant are picked and dried in a cool place. In order to determine the elemental composition of the samples, a mass spectral analysis was performed on the ICP-MS (inductively coupled plasma mass spectrometry method) AT 7500 equipment [5].

Preparation of the object for analysis: plant fruit samples were studied for comparison. Samples of 30 g of "Chocolate" persimmons and 25 g of "Lemon" persimmons are weighed on an electronic scale and finely ground. After grinding, 30 mL of concentrated nitric acid was added to the flasks and allowed to stand for 30 minutes until a clear solution was obtained. The obtained solutions were then filtered into 100 ml flasks and half of the flasks were filled with distilled water.

Diospyros fruit samples prepared above were analyzed in the semiquantitative analysis mode "Semiguant" in an inductively coupled plasma mass spectrometer. Device parameters: plasma power 1200 W, integration time 0.1 sec. Instrument calibration and quantitative calculations were performed based on the Agilent Technologist multi-element calibration standard (44 elements).

**Analysis of obtained results** table 1 presents the results of quantification of 41 elements. Arranged in ascending order of mass.

***Table 1***

**The content of elements in the persimmon plant, mg/kg**

| № | Element's name and sequence number | "Chocolate" persimmon fruit. | "Lemon" persimmon fruit |
|---|---|---|---|
| 1 | Li (3) | 0,016 | 0,141 |
| 2 | Be (4) | 0,010 | 0,008 |
| 3 | B (5) | 5,987 | 1,427 |
| 4 | Na (11) | 38,809 | 97,965 |
| 5 | Mg (12) | 95,568 | 569,334 |
| 6 | Al (13) | 27,991 | 321,750 |
| 7 | Si (14) | 1,459 | 4,093 |
| 8 | P (15) | 0,000 | 0,000 |
| 9 | S (16) | 81,640 | 61,289 |
| 10 | K (19) | 1607,731 | 1035,369 |
| 11 | Ca (20) | 1522,460 | 10527,452 |
| 12 | Ti (22) | 0,082 | 4,631 |
| 13 | V (23) | 0,045 | 1,167 |
| 14 | Cr (24) | 0,180 | 0,070 |
| 15 | Mn (25) | 1,150 | 6,259 |
| 16 | Fe (26) | 29,646 | 367,755 |
| 17 | Co (27) | 0,112 | 0,117 |
| 18 | Ni (28) | 0,450 | 26,014 |
| 19 | Cu (29) | 0,404 | 5,009 |
| 20 | Zn (30) | 0,967 | 6,219 |
| 21 | Ga (31) | 0,059 | 0,119 |

| | | | |
|---|---|---|---|
| 22 | Ge (32) | 0,001 | 0,002 |
| 23 | As (33) | 0,003 | 0,017 |
| 24 | Se (34) | 0,224 | 0,288 |
| 25 | Rb (37) | 0,462 | 0,223 |
| 26 | Sr (38) | 2,523 | 25,675 |
| 27 | Zr (40) | 0,015 | 0,100 |
| 28 | Nb (41) | 0,000 | 0,003 |
| 29 | Mo (42) | 0,129 | 0,035 |
| 30 | Ag (47) | 0,005 | 0,004 |
| 31 | Cd (48) | 0,013 | 0,023 |
| 32 | In (49) | 0,000 | 0,000 |
| 33 | Sn (50) | 3,082 | 2,561 |
| 34 | Sb (51) | 0,001 | 0,094 |
| 35 | Cs (55) | 0,001 | 0,000 |
| 36 | Ba (56) | 1,017 | 1,706 |
| 37 | Ta (73) | 0,003 | 0,003 |
| 38 | W (74) | 0,001 | 0,000 |
| 39 | Re (75) | 0,000 | 0,000 |
| 40 | Hg (80) | 0,180 | 0,127 |
| 41 | Pb (81) | 0,201 | 3,142 |
| 42 | Tl (81) | 0,005 | 0,004 |
| 43 | Bi (83) | 0,003 | 0,004 |
| 44 | U (92) | 0,013 | 0,024 |

*In parentheses - sequence number of element in periodic table

Analysis of the persimmon obtained for the elements listed in Table 1 shows that Ca > K > Mg > Al > Fe > Na > S > Si > Sr > Zn are present in the highest amounts. Among the macroelements (Table 2), Ca > K > Mg > S > Na prevails. Among trace elements, it was observed that Fe > Al > B > Sn > Sr were abundant. The fruit of the persimmon plant was brought as a sample from the zone of Baghdad district and the quantitative composition of the main elements was compared.

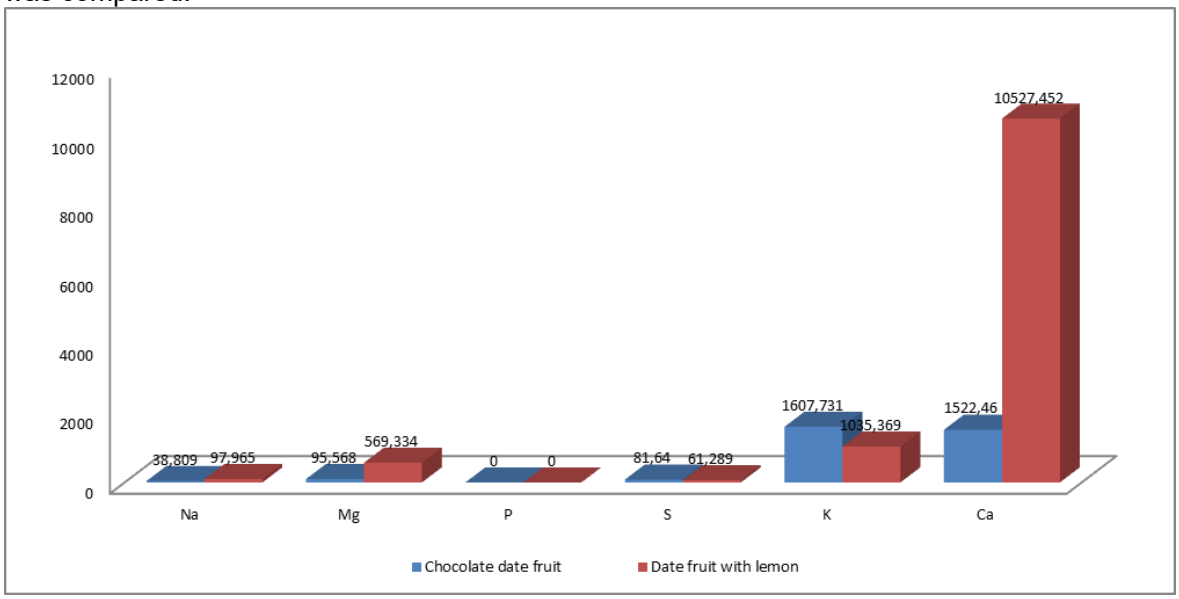
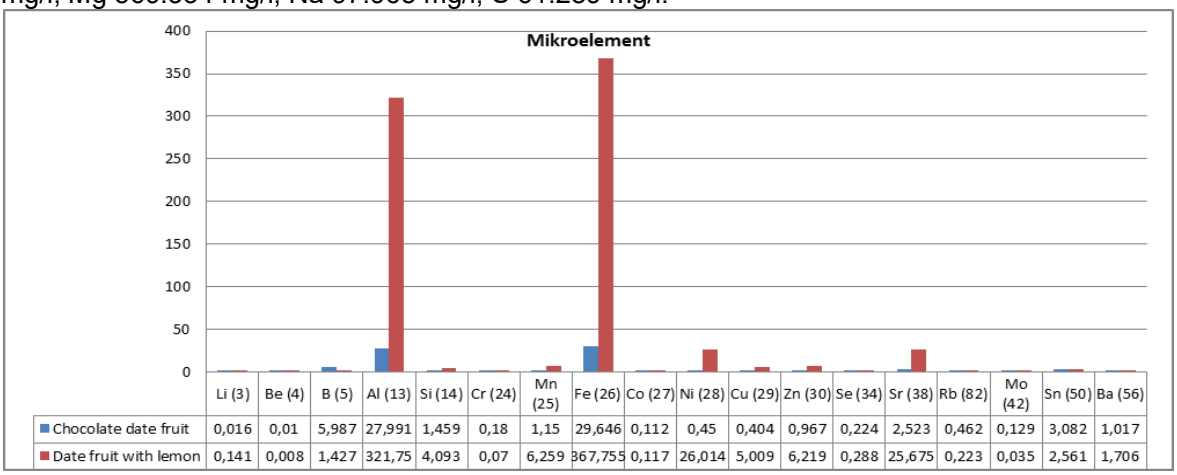



**Figure 1. Composition diagram of macroelements of fruits of persimmon (Diospyros) plant.**

Composition of macronutrients: Chocolate persimmon (Diospyros) fruit contains K 1607.731 mg/kg, Ca 1522.460 mg/kg, Mg 95.568 mg/kg, S 81.64 0 mg/kg, Na 38.809 mg/kg. It was found that the amount of macroelements in lemon persimmon fruit is Ca 10527.452 mg/l, K 1035.369 mg/l, Mg 569.334 mg/l, Na 97.965 mg/l, S 61.289 mg/l.




| | Li (3) | Be (4) | B (5) | Al (13) | Si (14) | Cr (24) | Mn (25) | Fe (26) | Co (27) | Ni (28) | Cu (29) | Zn (30) | Se (34) | Sr (38) | Rb (82) | Mo (42) | Sn (50) | Ba (56) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chocolate date fruit | 0,016 | 0,01 | 5,987 | 27,991 | 1,459 | 0,18 | 1,15 | 29,646 | 0,112 | 0,45 | 0,404 | 0,967 | 0,224 | 2,523 | 0,462 | 0,129 | 3,082 | 1,017 |
| Date fruit with lemon | 0,141 | 0,008 | 1,427 | 321,75 | 4,093 | 0,07 | 6,259 | 367,755 | 0,117 | 26,014 | 5,009 | 6,219 | 0,288 | 25,675 | 0,223 | 0,035 | 2,561 | 1,706 |

**Figure 2. Composition diagram of microelements of the fruits of persimmon plant (Diospyros).**

Composition of microelements Chocolate persimmon (Diospyros) fruit Fe 29,646 mg/kg, Al 27,991 mg/kg, B 5,987 mg/kg, Sn 3,082 mg/kg, Sr 2,523 mg/kg. The amount of trace elements in the lemon persimmon (Diospyros) fruit is Fe 367,755 mg/l, Al 321,750 mg/l, Ni 26,014 mg/l, Ti 4,631 mg/l, Si 4,093 mg/l.

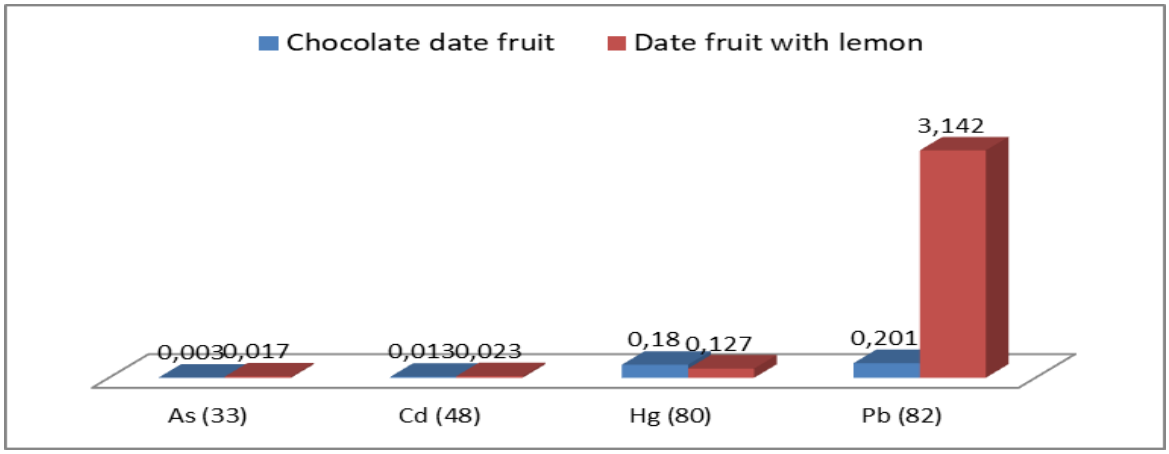



**Figure 3. Composition diagram of heavy elements of fruits of persimmon (Diospyros) plant.**

**Conclusion:** Thus, for the first time, the elemental composition of Baghdad samples of persimmon fruit was studied in detail. In this case, ICP-MS AT 7500 instrument using inductively coupled plasma mass spectrometry method was used. 41 elements were quantitatively determined in the fruit of persimmon. It was observed that there are 40 elements in the persimmon fruit of the "Chocolate" variety and 39 elements in the "Lemon" variety persimmon fruit. The natural tendency of the amount of an element to decrease with increasing mass is shown. It was observed that the amount of heavy elements (Table 3) in the fruit of the persimmon plant (Diospyros) is very small.

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