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## Elemental characterization of buckwheat (*Fagopyrum esculentum* Moench) cultivated in Turkey

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**Abstract**

This study, mineral and heavy metal contents of buckwheat (*Fagopyrum esculentum* Moench) newly imported foreign origin in our country were investigated. Buckwheat seeds cultivated at Konya ecological conditions at five different sowing dates and at different doses of fertilizer (0, 10 and 20 kg / da DAP-18-46) were obtained macro elements (Na, K, Ca, Mg and P), micro elements (Fe, Zn, Cu and Mn) and heavy metal (Al), were determined by ICP-OES. The analyses of mineral compositions in buckwheat seeds were determined using NMKL 161 method. It was determined that the amount of phosphorus (P) from macro nutrients in buckwheat seeds ranged from 1197-3778 ppm according to different sowing dates, and the amount of iron (Fe) from micro nutrients varied between 20.5-393.10 ppm. The amount of aluminum (Al) in heavy metals varied between 47.03-328.30 ppm. In this research, it was found that the seeds of the buckwheat (*Fagopyrum esculentum* Moench) grown at different planting dates and fertilizer doses show significant differences in mineral content.

**Keywords:** Buckwheat, Fagopyrum esculentum Moench, planting time, mineral element, seed

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### Introduction

Buckwheat (*Fagopyrum esculentum* Moench), a kind of plant belonging to the family Polygonaceae, is most commonly cultivated and produced in China, Russia, Ukraine and Kazakhstan, but in recent years, it has been cultivated all over the world and in particular in Asia, Europe and America (Kara, 2014). Meanwhile, Buckwheat has been produced in Turkey recent years.. Buckwheat is one of the most important pseudo cereal and a valuable raw material for functional foods and drug production since it is rich in essential amino acids, fatty acids, routine and vitamins, and it is also a good source of minerals. Additionally, researches conducted proved that buckwheat could also behave as antioxidant.

New entrance to the field of agriculture in our country in recent years, the plant is one of the buckwheat plant. In recent years, the researches on buckwheat in Turkey have been carried out in both production and Research & Development activities by different institutions and universities.. Buckwheat is a valuable source of minerals for the people who consume it. Buckwheat contains a relatively high level of some minerals (Ikeda and Yamashita, 1994; Ikeda et al., 1995). Buckwheat grains are an important source of micro elements, such as: Zn, Cu, Mn, Se and macro elements: K, Na, Ca, Mg (Wei et al.2003). Buckwheat seed contains some kinds of minerals at relatively high levels. Buckwheat minerals have beneficial effects on health: magnesium may contribute to maintenance of normal muscle and nerve function, healthy immune function, and bone health; potassium may reduce the risk of high blood pressure and stroke, in combination with a low sodium diet; zinc is the component of many enzymes and its deficiencies lead to retarded development of children, skin affections, acne and weakening of taste; phosphorus is an essential component of bones and teeth (Anonymus, 2009).

In this research, it was found that the seeds of the buckwheat (*Fagopyrum esculentum* Moench) cultivated in different planting dates and fertilizer doses showed significant differences in mineral content.

### Material and Method

**Material:** The seeds used in the study were obtained from Selcuk University, Faculty of Agriculture, Medicinal Plants Research and Application Farm, (Konya, Turkey).

The field experiments were carried out in Konya Seljuk University, Faculty of Agriculture, Medicinal Plants Research and Application Farm. Field experiments were conducted in 2012. Depending on the climatic conditions, buckwheat seeds were planted directly in the field, with the first sowing date in March 2012, the second sowing date in April 2012, the third sowing date in May 2012, the 4th sowing date in June 2012 and the 5th sowing date in June 2012. The fertilizer used in the experiments diammonium phosphate (DAP-18-46) was applied with three different doses (0, 10 and 20 kg / da).

**The analyses of mineral compositions in Bucwheat Seeds:** Mineral contents were determined in the seeds of buckwheat applied at different sowing times and fertilizer doses. The analyses of mineral compositions in buckwheat

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seeds (P, K, Ca, Mg, Mn, Zn, Al, Cu, Fe, Na) were determined using NMKL 161 method. A Perkin-Elmer Optima 2000 inductively coupled plasma–optical emission spectrophotometer (ICP–OES) was used to analyze the elements in buckwheat seeds.

**Results and Discussion**

The average results of the mineral contents determined in different fertilizer doses and buckwheat seeds cultivated at planting dates are given in Table 1. Macro elements (Na, K, Ca, Mg, P), micro elements (Fe, Zn, Mn, B) and Al were investigated.

The highest amount of phosphorus (P) one of the major macro elements (3778 ppm) was obtained from the first sowing date and the buckwheat seeds produced in the control plots, the lowest phosphorus content (1197 ppm) was obtained from the fifth sowing date and 20 kg / da fertilizer dose application. As can be seen, phosphorus content decreased as the sowing date was delayed. The amount of calcium (Ca) in the buckwheat seeds was the highest (13350 ppm) in the control plots at the first sowing date. On the other hand, the lowest amount of calcium (1051 ppm) was obtained from the third sowing date at 20 kg / da fertilizer dose application. Reduces were observed when the sowing date delayed in calcium content such like the phosphorus content. The highest amount of potassium (K) (5815 ppm) of buckwheat seeds was obtained from the first sowing date and produced from 10 kg / da fertilizer dose application, the lowest amount of potassium (2927 ppm) was determined in buckwheat seeds produced at the fifth sowing date and 20 kg / da fertilizer dose application. The highest amount of magnesium (Mg) was found at 2174 ppm and the second sowing date was determined at 10 kg / da fertilizer dose application, the lowest Mg was determined at 1636 ppm and the fifth sowing date at 20 kg / da fertilizer dose application. The highest sodium (Na) (179.1 ppm) was obtained from fertilizer dose application at 10 kg / da. The lowest Na was determined at 10 kg / da fertilizer dosing and first sowing date. There was no correlation between the amount of fertilizer applied and the macro elements accumulated in the seeds.

The amount of iron (Fe) from the micro nutrients was obtained from the highest second sowing date and 10 kg / da fertilizer dose application (393.10 ppm). The lowest amount of Fe was obtained from the fifth sowing date (20.5 ppm) and 20 kg/da fertilizer dose application. The highest amount of Zinc (Zn) was 55.59 ppm from the fifth sowing date and 20 kg / da fertilizer doses and the lowest amount of Zinc (Zn) was determined as 20.17 ppm from the first sowing date and 20 kg / da fertilizer dose.

Aluminum (Al) mineral is specified as heavy metal. Accordingly, the highest amount of Al was determined to be 375.5 ppm, the lowest amount of Al was found to be 50.44 ppm. The highest Al value was determined at 10 kg / da fertilizer dose and second sowing date, the lowest amount of Al was obtained of third sowing date and 20 kg / da fertilizer dose application.

In a study conducted under Konya ecological conditions, the average amount of phosphorus (P) was reported as 3666.70 ppm and the amount of iron (Fe) as 87.94 ppm (Kan, 2011). In addition, they determined that the buckwheat was rich in K, Zn, Ca, Mg, Mn and Na minerals (Wei et al., 2003). The content of Ca, Fe, Mg, Mn, Cu in the buckwheat flour was higher than that of wheat pasta (Tanaka, 1996). The lowest values of mineral nutrient content in buckwheat were determined in the plots without fertilizer (Kara and Telli, 2016). It should be noted that the high amounts of phosphorus and iron obtained in this study may be due to the ecological characteristics of the years of cultivation as well as the date of sowing applied.

**Conclusion**

The results indicated that mineral composition of buckwheat seeds significantly varied according to the fertilizer doses and sowing dates. High level of Mg, Fe, Mn and Cu obtained from the first and second sowing dates, despite that, high level of zinc (Zn) was determined from the 4th and the 5th sowing date. High level of Mn and Al were found in the seed of buckwheat. The compositions mineral of buckwheat seeds were effected by different fertilizer doses applied.

**Table 1.** Value of Buckwheat Seed Mineral Substances (ppm)

| Sowing date | Fertilizer Dose (kg/da) | Minerals (ppm) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ca | K | Mg | Na | P | Cu | Fe | Mn | Zn | Al |
| 1st Sowing Date (21.03.2012) | Control | 13350 | 5427 | 2042 | 115,2 | 3778 | 6,969 | 328,30 | 21,06 | 28,02 | 129,4 |
| | 10 | 1493 | 5815 | 1980 | 179,1 | 3634 | 6,24 | 108,60 | 13,84 | 30,2 | 69,82 |
| | 20 | 2317 | 5288 | 2037 | 60,01 | 3610 | 4,912 | 164,10 | 14,74 | 21,17 | 136 |
| 2nd Sowing Date (15.04.2012) | Control | 1831 | 4972 | 1918 | 72,67 | 3618 | 5,347 | 165,20 | 18,82 | 22,91 | 111,2 |
| | 10 | 4268 | 5250 | 2174 | 96,73 | 3551 | 5,846 | 393,10 | 23,9 | 25,83 | 375,5 |
| | 20 | 2886 | 5541 | 2096 | 155,7 | 3467 | 6,021 | 215,40 | 17,66 | 31,96 | 177,5 |
| 3rd Sowing Date (07.05.2012) | Control | 2598 | 4590 | 1971 | 118,8 | 2698 | 4,551 | 129,40 | 9,539 | 22,3 | 103 |
| | 10 | 2671 | 4654 | 1832 | 113,4 | 2384 | 4,715 | 163,70 | 11,92 | 23,73 | 130,3 |
| | 20 | 1051 | 4461 | 1701 | 71,64 | 2420 | 4,912 | 72,33 | 9,135 | 67,78 | 50,44 |
| 4th Sowing Date ı (22.05.2012) | Control | 1678 | 4160 | 1808 | 105,62 | 2237 | 4,821 | 120,20 | 10,60 | 43,01 | 123,5 |
| | 10 | 2478 | 3913 | 1774 | 105,85 | 2029 | 4,729 | 105,57 | 9,63 | 45,53 | 118,9 |
| | 20 | 2986 | 3667 | 1739 | 106,07 | 1821 | 4,638 | 90,94 | 8,67 | 48,04 | 114,3 |
| 5th Sowing Date (11.06.2012) | Control | 1896 | 3420 | 1705 | 106,30 | 1613 | 4,547 | 76,31 | 7,70 | 50,56 | 109,7 |
| | 10 | 2154 | 3174 | 1670 | 106,53 | 1405 | 4,455 | 61,68 | 6,74 | 53,07 | 105,1 |
| | 20 | 1896 | 3420 | 1705 | 106,30 | 1613 | 4,547 | 76,31 | 7,70 | 50,56 | 109,7 |

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