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Bioscience Research

Print ISSN: 1811-9506 Online ISSN: 2218-3973

Journal by Innovative Scientific Information & Services Network



RESEARCH ARTICLE

BIOSCIENCE RESEARCH, 2020 17(1): 294-297.

OPEN ACCESS

Determination of mineral nutrient content of Chia seeds (*Salvia hispanica* L.) grown in different environment conditions

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Due to its high nutritional and health promoting effects, there is an increasing interest in utilizing chia seed in the human diet. Chia (*Salvia hispanica* L.) is an annual cycle herbaceous plant belonging to the *Lamiaceae* family. The aim of this study was to determine the effect of different environmental conditions on mineral nutrient content. Chia plant was grown in Pamukkale University BiYOM greenhouse and Pamukkale natural land conditions. In this study, it has been mineral content analysis of plant seed *Salvia hispanica* grown in the greenhouse. Plants grown in different environmental conditions have different mineral content.

Keywords: Chia (*Salvia hispanica* L.), Mineral nutrient, greenhouse, natural land conditions

INTRODUCTION

Plants have an important place in human life and besides are used as foodstuffs. They are also used in the treatment of some diseases due to their medicinal properties. In spite of the great advances in modern medicine in recent years, plants contribute significantly to health services (Calixto et al. 2000). *Salvia hispanica* L. is one of the nature superfood sources (Özgören et al. 2018). Historical records reveal that Chia seeds were one of the basic foods in the diet of several Central American civilizations including Aztec and Mayan populations (Reyes-Caudillo et al. 2008; Chicco et al. 2009; Peiretti et al. 2009). Chia (*Salvia hispanica* L.) is a herbaceous plant belonging to Lamiaceae family and it is originated from southern Mexico northern (Magali et al. 2008; Bodoira et al. 2017).

Chia for commercial purposes has been cultivated in Argentina, Colombia, Ecuador, Peru, Bolivia, Paraguay and Australia. Its seeds are known for their antioxidant properties, dietary fiber and α -linoleic acid contents, which help prevent

several diseases (Magdalena et al. 2015; Oliveira-Alves et al. 2017; Martinez et al. 2012). Chia seeds are also an excellent source of other macro- and micro nutrients that are essential to human health because they contain high nutritional value proteins, fiber, calcium magnesium, iron the vitamin B complex and phenolic bioactive that have antioxidant properties. However knowledge of the mineral content in food is not sufficient to evaluate the nutritional quality. Phytic acid, tannins, oxalates and other components including fibers anti-nutritional factors may interfere with the accessibility of nutrients (Benevides et al. 2011). This plant seed is effective in preventing many diseases. It balances blood sugar and helps to feel satiated for longer. It has the ability to accelerate metabolism. It helps to burn more calories, accelerates fat burning (Vázquez-Ovando et al. 2009). Accelerates bowel movements, has the ability to relieve constipation. It protects the heart and brain system and strengthens the immune system and protects against diseases (Ayerza R. 1995). Mineral

substances are important for human health and have some duties in the human body. These tasks vitamin synthesis, hormone production, enzyme activity, tissue synthesis, energy production, O₂ transport, to ensure the continuity of physiological functioning, participate in the structure of tissues and organs in animals, to adjust the osmotic balance and acid-base balance in the body (Spears 1996, Arthur 2000; Eğritaş et al. 2015).

The aim of this study is to determine the effect of different environmental conditions on the mineral nutrient content of seeds. New generation seeds were obtained which is grown under different environmental conditions.

MATERIALS AND METHODS

Plant Materials

Chia (*Salvia hispanica* L.) plant seeds were obtained in Pamukkale University greenhouse and plants grown under natural land conditions. First section in our study; Using Chia seeds of Bolivian origin, tissue culture was made in Pamukkale University BİYOM. Seeds, Murashige and Skoog, 1962 basal medium (MS) 3% sucrose, 7% agar with 0,4 mg l⁻¹ gibberellic acid (GA₃) and 10 mg l⁻¹ were grown in vitro in the medium supplemented with ascorbic acid (AA). About 4 weeks after germination, the flowerpot was transferred in greenhouse. Chia is a slow-growing plant that germinates quickly. Chia plant has completed its development in about ten months. Seeds were collected in November-December after completing their development. Second section in our study; Chia seeds of Bolivian origin were cultivated in soil under Pamukkale natural land conditions. Chia seed germination was to within one week. Chia plant completed its development process in about eleven months. Seeds were collected in December after completing their development.

Preparation of Seed Extracts

The seeds collected were shredded with a blender (Waring commercial blender) in our laboratory. Twenty-five grams of each sample was transferred to Erlenmeyer flasks and 250 ml of methanol (96% Merck) was then added as solvent. The extraction was carried out by standing in a temperature-controlled water bath apparatus for 6 hours. The extract was then separated from the sample residue by filtration through Whatman No. 1 filter paper. The solvent portion of the extracts obtained was removed in a rotary evaporator (IKA RV 10). All extracts were

lyophilized (Labconco FreeZone, Kansas City, MO) and stored in a refrigerator at -4 °C until use. The mineral nutrient content of the obtained chia seeds was determined by specific tests.

Statistics analysis

Statistical calculations were performed using IBM Whitney U test in IBM SPSS Statistics 23 program.

RESULTS AND DISCUSSION

In a study, Ca, K, Mg, Fe and Zn content was analyzed in cereal products and it was found that trace element contents were very different from those of 30 years ago (Ekholm et al., 2007). In another study conducted in Mexico, content analyzes were performed and flame photometric and spectrophotometric procedures for fruits and vegetables (K, P, Mg, Fe) were compared with the results of the UK and German food composition tables. Overall, there was no consistent difference between European and Mexican data, but Mexican fruit tended to have a lower P content (Castillo et al. 1998).

In our study, the presence of phosphorus, potassium, magnesium, zinc and iron minerals was determined in *Chia* seeds. In the results of mineral content analysis of plant seeds of Chia grown in the greenhouse, which was used in this study; Phosphorus content 10200, 00 mg/kg, potassium content 7361, 00 mg/kg, magnesium content 3823, 00 mg/kg, zinc content 114,80 mg/kg and iron content 75, 27 mg/kg was found. In the results of mineral nutrient content analysis of plant seeds of Chia grown in the Pamukkale natural land conditions, which was used in this study; Phosphorus content 19616,79 mg/kg, potassium content 1340,50 mg/kg, magnesium content 1914,16 mg/kg, zinc content 53,25 mg/kg and iron content 26,50 mg/kg was found. It has been observed that different environmental conditions effect the mineral content

While the phosphorus content of the seeds grown in greenhouse was 10200.00 mg/kg, it was found to be 19616.79 mg / kg in the seeds grown under natural soil conditions. While the magnesium content of the seeds grown in greenhouse was found to be 3823,00 mg/kg, it was found 1914,16 mg / kg in the seeds grown in natural land conditions. While the potassium content of the seeds grown in Pamukkale University BİYOM greenhouse was found to be 7361, 00 mg/kg, it was found 1340,50 mg/kg in the seeds grown in natural land conditions.

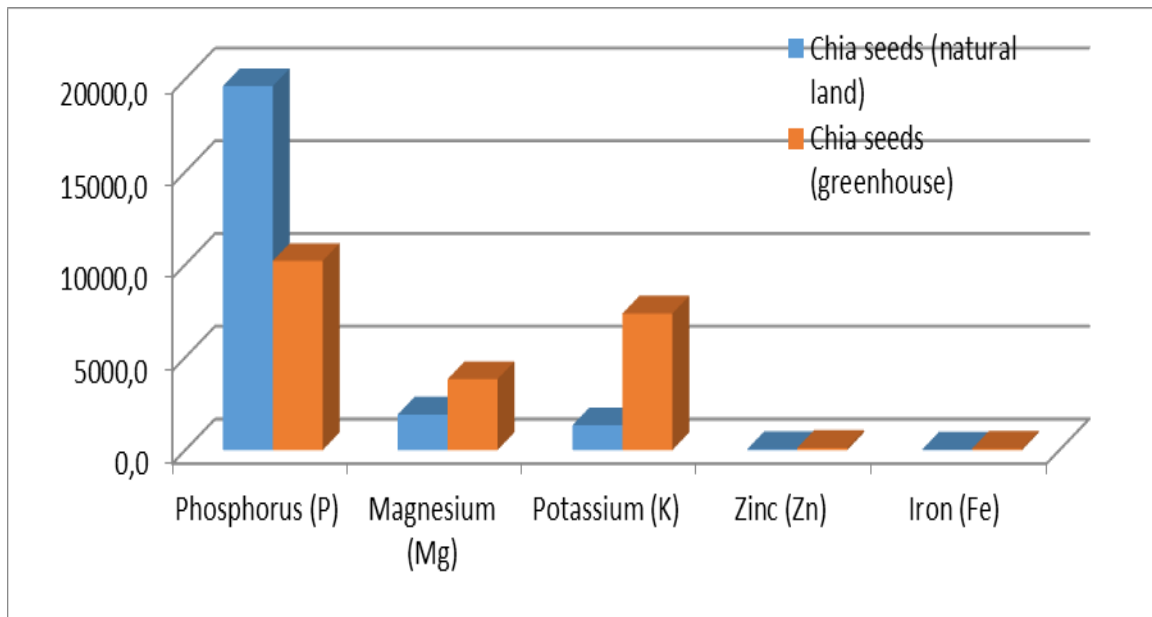


Figure 1: Mineral content of Chia (*Salvia hispanica* L.) seeds grown by under different environmental conditions.

While the zinc content of the seeds grown in greenhouse was found to be 114,80 mg/kg, it was found 53,25 mg/kg in the seeds grown in natural land conditions. While the iron content of the seeds grown at greenhouse was found to be 75,27 mg / kg, it was found 26,50 mg / kg in the seeds grown in natural land conditions. (Figure 1).

As a result; Chia seeds grown in natural field conditions contain high amount of phosphorus; phosphorus magnesium; potassium; zinc; it has iron minerals. Chia seeds grown in greenhouse conditions contain high amount of phosphorus; phosphorus; potassium; magnesium; zinc; it has iron minerals. The amount of phosphorus mineral is higher in Chia seeds grown under natural conditions than grown under greenhouse conditions. The amount of magnesium, potassium, zinc and iron minerals is higher in Chia seeds grown under greenhouse conditions than grown under natural conditions.

CONCLUSION

Chia plant was grown in Pamukkale University BİYOM greenhouse and Pamukkale natural land conditions. In the results of mineral content analysis of plant seeds of *Salvia hispanica* L. grown in the BİYOM greenhouse, which was used in this study; the mineral content of seeds obtained by growing in two different regions were determined. As a result of the analyzes, it was

determined that different environmental conditions affect the mineral content of Chia seeds.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

ACKNOWLEDGEMENT

I would like to my gratitude to Pamukkale University, BİYOM employees who contributed to of my study.

AUTHOR CONTRIBUTIONS

Yeşim Kara: Conceived the idea, planned for the study and writing the article. This study was done by Yeşim Kara from Nesrin Erim's graduate thesis.

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