Available online freely at www.isisn.org

Bioscience Research

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

Journal by Innovative Scientific Information & Services Network

RESEARCH ARTICLE BIOSCIENCE RESEARCH, 2023 20(1): 142-145. **OPEN ACCESS**

Determination of oil and fatty acids content of Chia seeds (*Salvia hispanica* L.) grown in different environment conditions

Nesrin Erim and Yeşim Kara*

Pamukkale University, Department of Biology, Faculty of Science, 20017, Denizli **Turkey**

***Correspondence: yesimopak@gmail.com** **Received: 09-02-2023, Revised: 25-03-2023, Accepted: 28-03-2023 e-Published: 31-03-2023**

The basis of our research; It is to determine whether the oil yields in Chia (*Salvia hispanica* L.) seeds grown in two different environments change and if so, at what rates. These environments were chosen as greenhouse conditions and natural agricultural land. After the M1 generations were obtained, seed oil analyzes were performed, the percentages of fatty acids were measured and the following conclusion was reached: In the oil analysis of chia seeds, linolenic acid (64.019%) in seeds obtained from Greenhouse conditions, linoleic acid (20.967%) in seeds obtained from natural field conditions measured high. While the content of linoleic acid (omega 6) from omega fatty acids is higher in Chia seeds grown in natural field conditions; Palmitoleic acid (omega 7), oleic acid (omega 9), linolenic acid (omega 3) content is higher in Chia seeds grown under greenhouse conditions. As a result, it was determined that the oil content of Chia seeds may differ depending on different growing environments.

Keywords: Chia (*Salvia hispanica* L.), natural terrain conditions, greenhouse, fatty acids, oil.

INTRODUCTION

Chia (*Salvia hispanica* L.) is an annual herbaceous plant originating from Latin America, and its family is Lamiaceae. About 900 species belong to the Lamiaceae family in the genus Salvia (Lu and Foo, 2002). Numerous scientific research reporting the isolation of diterpenoids and polyphenols from various plant components have focused on this breed (Dorman et al. 2003). *Salvia hispanica* L., also referred to as "Chia" (Ayerza, 1995). The chia plant features little, black and white seeds and purple blooms (Ali et al. 2012). Chia is a plant that grows naturally in tropical and subtropical climes, and it is raised there (Orozco et al. 2014). It is a plant grown commercially in Latin American countries (Busilacchi et al. 2013). Chia is thought to have great potential for utilization in the future (Small 2011; Jamboonsri et al. 2012; Busilacchi et al. 2013; Guiotto et al. 2013). The chia plant's productivity and seed quality are influenced by the environment (Ayerza 2010; 2011). Depending on the place where they are farmed, chia seeds are produced at varied rates; contains 90-93% minerals, vitamins, and antioxidants, along with 15-25% protein, 30-33% fat, 26-41% carbs, and 18-30% dietary fiber (Ixtaina et al. 2008). Chia seeds are employed in the fight against obesity because they are high quality fiber foods, have a reducing effect on cholesterol, and are rich in Omega-3 and Omega-6 fatty acids (Amato et al. 2015; Ixtaina et al. 2008). In this area, chia has been grown for thousands of years (Ixtaina et al. 2008; Ayerza and Coates, 2009; Borneo et al. 2010; Ayerza and Coates, 2011; Capitani et al. 2012). Due to the health advantages connected with their make-up, chia seeds have recently been incorporated into the human diet (Borneo et al. 2010; Ixtaina et al. 2011; Capitani et al. 2012). Ixtaina et al. (2008) and Marineli et al. (2014) state that chia has been studied and is advised for consumption due to its high concentration of fatty acids that are good for the body, proteins, antioxidants, and dietary fiber. The composition of fatty acids in plants determines the physical and chemical properties of oils and enables their use in various industrial sectors. Fatty acids contained in plants are divided into saturated fatty acids and unsaturated fatty acids. Saturated fatty acids are fatty acids that form single bonds between carbon atoms (C) and are solid at room temperature (Anon, 2004). myristic acid (C14:0), palmitic acid (C16:0), stearic acid (C18:0) is the major saturated fatty acid in plants. Unsaturated fatty acids are fatty acids containing double bonds between carbon atoms in different regions of the carbon chain. Unsaturated fatty acids are more reactive than natural fatty acids due to the double bonds in their structure (Nas et al. 2001). Unsaturated fatty acids have a significant impact on brain function. The fatty acid composition of plants is influenced by various environmental factors, especially temperature, drought and soil structure. In this direction, it is concluded that plant cultivation under different environmental conditions influences plant fatty

acid composition.

The aim of this study is to analyze the fatty acid content of chia seeds grown in different environmental conditions in new generation seeds, and to determine their ratios and the effects of environmental conditions on the fatty acid content yield. (Natural field conditions and greenhouse).

MATERIALS AND METHODS

Material

In our study environment, M1 generations of Chia plant (*Salvia hispanica* L.) seeds were grown in Pamukkale university greenhouse and natural land soils of Pamukkale district of Denizli Province. In the first stage of our study; Chia seeds from Bolivia were grown in vitro on Murashige and Skoog, 1962 MS (3% sucrose, 7% agar, 0.4 mg 1^{-1} gibberellic acid (GA_3) and 10 mg 1^{-1}) medium. Transplanted into pots 4 weeks after germination. These plants have completed their life in ten months.

In the other part of the study; Chia seeds of the same origin were cultivated in the soil by planting in the natural agricultural land of Pamukkale district of Denizli Province. M1 seeds were collected from plants that completed their development in approximately 11 months and analyzed.

Fatty acid determination

First generation Chia seeds obtained from *Salvia hispanica* L. plant were ground with a Waring commercial mixer, weighed 1/10 on a precision balance (Grecisa XW210A) and extracted using methanol (Merck-Germany) as a solvent for 6 hours in a water bath device.Then, it was dried in a lyophilizer (Labconco Freezone 6 U.S.A) device, taken into dark glass bottles, tightly closed and stored at -4 °C. Necessary procedures were carried out to determine the content of oil analyzes. Agilent brand gas chromatography-mass spectroscopy device was used for oil analysis (AGILENT 5975 ºC AGILENT 7890A GC MS).

RESULTS AND DISCUSSION

The yields of the fatty acids content shown in Table 1 were determined using a methanol-Chloroform solvent. When the results are evaluated; The yields of the fatty acids content shown in Table 1 were determined using a methanol solvent. When the results are evaluated; The oil yield in the first generation seeds of Chia seeds grown under different environmental conditions is much richer in terms of linoleic acid (omega 3), compared to those grown under greenhouse conditions. It is much richer than those grown under greenhouse conditions.

Tablo 1: Fatty acid percentage content of chia (*Salvia hispanica* L.) seeds

Fatty acids Solvent (chloroform- methanol)	Rt	NTC* (%)	GC* (%)
Myristic (C14:0)	13,8	0,1	0,081
Palmitic (C16:0)	18,2	6,964	9,123
Stearic (C18:0)	27	1,647	2,264
Palmitoleic (C16:1)	19	0,144	0,245
Oleic (C18:1)	27,5	6,48	6,484
Linoleic (C18:2)	29,2	20,967	17,594
Linolenic (C18:3) Omega 3	31,5	62,77	64,019

*NTC: Natural Terrain Conditions. GC: Greenhouse Conditions

Chia seeds are used in medicine, treatment of many diseases, pharmacology and food industry thanks to the omega fatty acids, antioxidants, minerals, vitamins, protein, high fiber and low calories they contain. The consumption of chia seeds prevents cardiovascular diseases, regulates diabetes and the immune system (Mclements et al. 2007). Chia seed oil reduces serum fat profiles and sugar levels in rats and humans. It has been determined that α-linolenic acid in chia reduces psychiatric diseases in adults (Freeman et al. 2006). In addition, it has been determined that chia oil can be an alternative to omega-3 sources for people who are allergic to fish and fish products and vegetarians due to its high α-linolenic acid ratio (Ayerza and Coates, 2005a). With the idea that the production and consumption of the chia plant in our country can be expanded, all these and similar studies have been effective in determining the subject of our study. Fatty acids typically exist in varying levels of abundance. The most common fatty acids are linolenic acid (C18:3), linoleic acid (C18:2) and palmitic acid (C16:0). However, other fatty acids such as oleic acid (C18:1) and stearic acid (C18:0) can also be found in small amounts (Ixtaina et al. (2011).

The oils in the content of plant seeds are of great importance for human health. Palmitoleic acid (omega 7), oleic acid (omega 9), linoleic acid (omega 6), and linolenic acid (omega 3), which is one of the omega fatty acids, affect many body functions, especially brain functions. Chia seeds are rich in omega fatty acids, which are essential for a healthy diet. Chia seeds grown in different conditions contain very low amounts of saturated fatty acids myristic acid, palmitic acid, and stearic acid, and high levels of omega fatty acids palmitoleic acid (omega 7), oleic acid(C18:1) (omega 9), linoleic acid(C18:2) (omega 6), linolenic acid(C18:3) contains (omega 3). Among the saturated fatty acids, myristic acid content is higher in Chia seeds grown under natural field conditions, while palmitic acid and stearic acid content are higher in Chia grown seeds under greenhouse conditions. While the content of linoleic acid (omega 6) from omega fatty acids is higher in Chia seeds grown in natural field conditions; Palmitoleic acid (omega 7), oleic acid (omega 9), linolenic acid (omega 3) content is higher in Chia seeds grown under greenhouse conditions.

As a result; It was determined by us that different environmental conditions, plant growth physiology, and M1 generation product content was affected. In the results of fatty acids content analysis of plant seeds of *Salvia hispanica* L. grown in the greenhouse, which was used in this study; the fatty acids content of seeds obtained by growing in two different regions was determined. This research will contribute to the studies related to the Chia plant and will be useful in modern medicine applications, the food industry, and production.

CONCLUSION

Chia (*Salvia hispanica* L.) seeds that we used in this research were grown in two different environments and then the M1 generations were compared in all respects. While the content of linoleic acid (omega 6) from omega fatty acids is higher in Chia seeds grown in natural field conditions; Palmitoleic acid (omega 7), oleic acid (omega 9), linolenic acid (omega 3) content is higher in Chia seeds grown under greenhouse conditions.

CONFLICT OF INTEREST

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

ACKNOWLEDGEMENT

This study was supported by the Scientific Research Projects Coordination Department at Pamukkale University. Project No: 2017FEBE047. I would like to my gratitude to Pamukkale University, BAP employees who contributed to our study.

AUTHOR CONTRIBUTIONS

This article was written by Yeşim Kara from Nesrin Erim's graduate thesis.

REFERENCES

Ali NM, Yeap SK, Ho WY, Beh BK, Tan Swand Tan SG. 2012. The prom ising future of Chia (*Salvia hispanica*)Hindawi publishing Corporation Journal of Biomedicine and Biotechnol, 9, 3-9.

Ayerza R and Coates W. 2005a. Effect of ground chia seed and chia oil on plasma total cholesterol, LDL, HDL, triglyceride content, and fatty acid composition when fed to rats. Nutr. Res, 11, 995-1003.

Ayerza R and Coates W. 2011. Protein content, oil content and fatty acid profiles as potential criteria to determine the origin of commercially grown chia (*Salvia hispanica* L.). Industrial Crop and Products, 34, 1366-1371.

Ayerza R and Coates W. 2011. Protein content, oil content and fatty acid profiles as potential criteria to determine the origin of commercially grown chia (*Salvia hispanica* L.). Industrial Crop and Products, 34, 1366-1371.

Ayerza R. 1995. Oil content and fatty acid composition of chia (*Salvia hispanica* L.) from five northwestern locations in Argentina. Journal of the American Oil Chemists Society, 72, 1079-1081.

Ayerza R. 1995. Oil content and fatty acid copozition of Chia (*Salvia hispanica*) from five Northwestern Location in argentina . Journal of the Emerican oil Chemists Society, 72 (9), 1079-81.

Ayerza R. 2010. Effects of seed color and growing locations on fatty acid content and composition of two Chia (*Salvia hispanica* L.) genotypes. Journal of the american oil chemists society, 87(10), 1161-1165.

Ayerza R. 2011. The seeds oil content and fatty acid copozition of Chia *Salvia hispanica* L. variety Iztac 1, grown under six tropical ecosystems conditions. Interciencia, 8, 620-624.

Borneo R, Aguirre A and León, AE. 2010. Chia (*Salvia hispânica* L.) gel can be used as egg or oil replacer in cake formulations. Journal of the Academy of Nutrition and Dietetics, 110, 946-949.

Busilacchi H, Quiroga M Bueno M, Di Sapio O, Floves V, Severin C. 2013. Evaluacition de *Salvia hispanica* l. Cultivada en el Sur Santa Fe (Republica Argentina) Cultivos Tropicales, 34, 55-59.

Capitani MI, Spotorno V, Nolasco SM and Tomás MC. 2012. Physicochemical and functional characterization of by-products from chia (Salvia hispanica L.) seeds of Argentina. LWT – Food Science and Technology, 45, 94-102.

Coorey R, Grant A and Jayasena V. 2012. Effect of Chia flour incorporation on the nutritive quality and consumer acceptance of chips. Journal of Food Research, 1, 85-95.

Dorman HJD, Peltoketo A, Hiltunen R and Tikkanen MJ. 2003. Characterization of the antioxidant properties of de-odourised aqueous extracts from selected Lamiaceae herbs. Food Chemistry, 83, 255-262.

Freeman MP, Hibbeln JR, Wisner KL, Davis JM, Mischoulon D, Peet M, Keck PE Jr, Marangell LB, Richardson AJ, Lake J, Stoll AL. 2006. Omega-3 fatty acids: evidence basis for treatment and future research in psychiatry. The Journal of Clinical Psychiatry, 67(12), 1954-67.

Guitto EN, Ixtana VY,Tomas MC, Nolasco SM. 2013. Moisture dependent engineering properties of Chia seeds. In:Food Industry, Intech, 381-397.

Ixtaina VY, Nolasco SM and Tomás MC. 2008. Physical

properties of chia (*Salvia hispanica* L.) seeds. Original Research Article. Industrial Crop and Products, 28, 286-293.

Ixtaina Y, Nolasco S, Tomas MC. 2008. Physical properties of Chia seeds. Industrial crops and Products, 28, 286-293.

Jamboonsri W, Phillips TD, Geneve RL, Cahill JP, Hildebrand DF. 2012. "Extending the Range of an Ancient Crop, (*Salvia hispanica* L).-a New Omega-3 Source", Genetic Resources and Crop Evolution. 59(2), 171-178.

Lu Y and L Yeap Foo. 2002. Polyphenolics of Salvia-a review. Phytochemistry. 59, 117-140.

Marineli RS, Moraes EA, Lenquiste SA, Godoy AT, Eberlin MN and Maróstica-Jr, MR. 2014. Chemical characterization and antioxidant potential of Chilean chia seeds and oil *(Salvia hispanica* L.). LWT Food Science and Technology, 59, 1304-1310.

Mc Clements DJ, EA Decker, Weiss J, 2007. Emulsion-based delivery systems for lipophilic bioactive components. Food Sciences, 72(8),109-24.

Murashige T and Skoog F. 1962. A revised medium for rapid growth and bio assays with tobacco tissue cultures. Plant Physiology, 15, 473-497.

Nas S, Gökalp YH, Ünsal M. 2001. "Vegetable Oil Technology", Pamukkale University Faculty of Architecture Printing House, pp.322.

Orozco RG, Duran PN, Gonzales EDR, Zaracú VP, Ramirez OP. 2014. Proyecciones de cambio climático y potencial productivo para L. en las zonas agrícolas de México. Rev Mex Sci Agric, 10, 1831-1842.

Small E. 2011. "Blossoming treasures of biodiversity", Biodiversity, 12(1), 49-56.