

## Abstract

# Podophyllotoxin Content Analysis of *Linum album* Kotschy ex Boiss. Subjected to Short-Term Potassium Deficiency Stress <sup>†</sup>

Zahra Danaeipour <sup>1</sup>, Ghasemali Garoosi <sup>1,\*</sup>, Masoud Tohidfar <sup>2,\*</sup>, Mohammad Reza Bakhtiarizadeh <sup>3</sup>   
and Mohammad Hossein Mirjalili <sup>4</sup>

<sup>1</sup> Department of Biotechnology, Faculty of Agriculture and Natural Resources, Imam Khomeini International University, Qazvin 3414916818, Iran

<sup>2</sup> Department of Plant Biotechnology & Life Science, Shahid Beheshti University, Tehran 1983969411, Iran

<sup>3</sup> Department of Animal and Poultry Science, College of Aburaihan, University of Tehran, Tehran 3391653755, Iran

<sup>4</sup> Department of Agriculture, Medicinal Plants and Drugs Research Institute, Shahid Beheshti University, Tehran 1983969411, Iran

\* Correspondence: garoosi@eng.ikiu.ac.ir (G.G.); gtohidfar@yahoo.com (M.T.)

<sup>†</sup> Presented at the 8th International Electronic Conference on Medicinal Chemistry, 1–30 November 2022; Available online: <https://ecmc2022.sciforum.net/>.

**Abstract:** Podophyllotoxin (PTOX), one of the most important natural medicinal compounds, has anticancer properties. Its effective medicinal derivatives, such as etoposide and teniposide, have been approved by the Food and Drug Administration (FDA) for cancer treatment. This compound is found as a specialized metabolite in the *Linum album* Kotschy ex Boiss., belonging to the Linaceae family. PTOX is the major aryltetralin lignan resulting from the shikimic acid/phenylpropanoid pathway, and it accumulates in the shoots and roots of *L. album*. PTOX plays a necessary role in plant defense systems, protecting against abiotic as well as biotic stresses and helping their adaptation to adverse environmental conditions. Therefore, the content of specialized metabolites increases under stress. In this study, the content of PTOX under stressful conditions (potassium deficiency stress at two time points: 12 and 48 h) was examined using High Performance Liquid Chromatography (HPLC) in a completely randomized design with three replications. The results of HPLC showed that the content of PTOX first decreased after 12 h, while after 48 h of treatment, compared with the control plants, it showed a significant increase, with a value of 135.8 in the shoots. In the roots, the results were consistent with the results of the aerial parts, and the amount increased significantly after 48 h. In general, the results show that *L. album*, as a suitable natural source for PTOX, has great potential to generate large-scale products for commercial and pharmaceutical purposes.

**Keywords:** *Linum album*; podophyllotoxin; anticancer; potassium deficiency



**Citation:** Danaeipour, Z.; Garoosi, G.; Tohidfar, M.; Bakhtiarizadeh, M.R.; Mirjalili, M.H. Podophyllotoxin Content Analysis of *Linum album* Kotschy ex Boiss. Subjected to Short-Term Potassium Deficiency Stress. *Med. Sci. Forum* **2022**, *14*, 115. <https://doi.org/10.3390/ECMC2022-13420>

Academic Editor: Maria Emília Sousa

Published: 1 November 2022

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

**Supplementary Materials:** The following are available online at <https://www.mdpi.com/article/10.3390/ECMC2022-13420/s1>.

**Author Contributions:** Conceptualization, Z.D. and M.T.; methodology, Z.D. and M.T.; formal analysis, Z.D. and M.R.B.; investigation, Z.D.; resources, Z.D., G.G. and M.H.M.; data curation, Z.D. and M.T.; writing—original draft preparation, Z.D.; writing—review and editing, Z.D., G.G., M.T. and M.H.M.; visualization, Z.D.; supervision, G.G. and M.T.; project administration, G.G. and M.T.; funding acquisition, G.G. and M.H.M. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** Not applicable.

**Conflicts of Interest:** The authors declare no conflict of interest.