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**Assessment of the doctoral dissertation by Kavana Raj, MSc
entitled „Developmental and agrotechnical factors influencing the yield and quality of
valerian raw material”**

**performed in Department of Vegetable and Medicinal Plants, Institute of Horticultural
Sciences, Warsaw University of Life Sciences,
under the scientific supervision of Professor dr hab. Katarzyna Bączek and Assistant
supervisor Dr Jarosław L. Przybył**

1. Preliminary information

The legal basis for the review of the dissertation and publication of Kavana Raj, PhD student of the Doctoral School of the Warsaw University of Life Sciences entitled „Developmental and agrotechnical factors influencing the yield and quality of valerian raw material” is based on my appointment as the reviewer of the doctoral dissertation by the Council of the Agriculture and Horticulture Discipline at the Warsaw University of Life Sciences (SGGW), Resolution No. 37/RiO2025/2026 dated on April 9, 2026. According to current regulations, I have not received any data concerning personal data, scientific background, appropriate activity, as well as the nationality of the PhD Student.

2. Evaluation of the formal structure of the dissertation

The PhD thesis manuscript is written in English and comprises a description in the form of a manuscript of 55 standardized, numbered, typed pages. Two original scientific publications, thematically consistent, constitute an achievement submitted for evaluation and are also assessed. In the two presented publications, the Doctoral Student is the first author. The first of the listed publications was published in a scientific journal “Molecules” with a high impact factor (IF) of 5.1, whereas the second—an extensive study—forms part of the book Natural Products published by Springer, Berlin, Heidelberg. It is an original scientific study. In the manuscript submitted for review, the Doctoral Student has distinguished eight main chapters, each with further sub-chapters. This structure of dissertation is correct and standard for this type of presentations according to: Regulations governing proceedings for the conferral of the doctoral degree at the Warsaw University of Life Sciences (SGGW) for persons who have



completed their education at a Doctoral School - Appendix No. 3 to Resolution No. 89 – 2022/2023 of the Senate of SGGW of 26 June 2023 regarding the adoption of the regulations for conducting proceedings for the conferral of the doctoral degree at the Warsaw University of Life Sciences (SGGW). Relevant background and methodological information are presented in 26 figures and three tables. The extensive English-, German-, and Polish-language literature includes 102 entries. In the text of the work, the literature is cited correctly, and bibliographic references are in the right places. The work's layout and structure follow generally accepted principles for writing scientific papers. Although the doctoral dissertation consists of only two published articles, the original scientific research presented in them is multifaceted, and the works are extensive, I conclude that the formal aspects of the work do not raise significant objections.

3. Evaluations of research issues

Current research data indicate that valerian is a safe herbal remedy that may offer benefits for mild insomnia and anxiety. However, its clinical efficacy is moderate and inconsistent. Although some patients report improved sleep quality, there is insufficient objective evidence. Consequently, valerian is considered an adjunct rather than an alternative to therapies with proven efficacy for chronic insomnia. However, according to recommendations, the initial beneficial effects of valerian's biologically active substances are generally expected only after about two weeks of regular use, rather than after a single dose. *Valeriana officinalis* L. is a pharmacopoeial plant.

This means that its medicinal raw material is described in official pharmacopoeias, such as the European Pharmacopoeia and the Polish Pharmacopoeia. Pharmacopoeias specify requirements regarding the identity of the raw material, purity, active substance content, and quality control methods. In the case of valerian, the pharmacopoeial raw material is primarily: valerian root *Valerianae radix*, i.e., the dried underground parts of the plant (roots and rhizomes). Valerian plant material is subject to standardization, as the content of biologically active substances is strictly defined. Consequently, it is important to understand the agrotechnical and genetic factors that influence the quantity and quality of the plant material. This problem was taken up by a Doctoral Student, who presented interesting research in her doctoral dissertation. I consider both the title and the issues presented in the dissertation and in the previously published scientific papers to be pertinent, up to date, and of great scientific and practical relevance. The research presented will facilitate the selection of suitable sowing material, cultivation methods, and growing sites for valerian *Valeriana officinalis*, as well as the choice of the appropriate plant material fraction for the production of herbal medicinal products. This is a complicated but also challenging task for any scientist, and even more so for one who is at the beginning of his or her scientific career. A researcher needs to be inquisitive, honest, and thorough. Having read both the text of the manuscript and the publications



presented for evaluation, I conclude that the MSc. Kavava Raj possesses all these qualities.

4. Substantive assessment of the dissertation

The 'Introduction' is correctly written, and it is easy to follow the logic of the Author. In the section of the literature review—briefly titled by the PhD student "Literature"—the plant's morphology, species, and cultivation, as well as the chemical composition of essential oil, action, and application of the plant material are presented. The aim of the work, hypothesis and objectives have been correctly formulated and planned. The PhD student focused on determining how cultivation methods—specifically 1-year versus 1.5-year cycles and exposure to full sun versus 50% reduced light—as well as the phenomenon of bolting, affect the content and composition of active substances, particularly essential oil and sesquiterpene acid. A subsequent stage of the research involved the chemical analysis of various fractions of the raw plant material as well as comparing their chemical composition with that of wild plants. The study also took into account the fraction of thin roots with a diameter of less than 2 mm — material that is typically discarded at the very beginning of the processing stage. The PhD student set herself the main research tasks, which she consistently fulfilled. Noteworthy is the impressive number of samples tested of methanol extracts and essential oils using HPLC-DAD and GC-MS and GC-FID analysis. It demonstrates the in-depth knowledge and the hardworking and versatile skills of the PhD student. However, the doctoral thesis has minor shortcomings. They concern, for example, differences in the number of plants or replicates examined. The number of replicates for the tested samples should be identical so that the results are comparable. In the material and methods chapter, the PhD student presented a description of the research materials as well as the description of the methods used in the study. I consider the research methods to be described in overly general terms. More detailed descriptions can be found in the publications submitted for evaluation. However, the author too frequently repeats the description of the preliminary preparation of the herbal raw material across the various studies. This procedure is identical in all the studies and does not require repeated descriptions.

All test methods, substrates, and reagents were carefully selected for the conducted studies. The chapter dedicated to the results and their discussion is quite short—only seven pages. Furthermore, only a few bibliographic sources were used in the discussion. Detailed descriptions of the results and discussions can be found in the publications submitted for review. During the years of research, the doctoral student performed many chemical analyses. This demonstrates her extensive knowledge and good analytical training, as I conclude after reviewing the content of the attached scientific publications. The research of M.Sc. Kavava Raj has supplemented the existing knowledge on the cultivation of *Valeriana officinalis*, the content of raw material, as well as about differences between the chemical composition of wild and cultivated valerian plants.

Valerian is a species that exhibits various chemotypes depending on the content of its



biologically active substances. The most valuable chemotype is the one containing high levels of valerenic acid. Consequently, to ensure consistent therapeutic effects, research institutes (such as SGGW and IUNG in Poland) study specific cultivars—such as the Polish "Lubelski" variety—to select lines based on their valerenic acid concentration. The research presented by the doctoral student was co-financed by the Ministry of Agriculture and Rural Development under the project "Genetic and developmental aspects of yield and raw material quality in valerian" (Task No. 32), carried out between 2021 and 2024.

Based on her experiments, the PhD student drew six complex conclusions from the content of the research. These conclusions are logical and answer the research tasks set by the PhD student. Additionally, regarding the second publication submitted for evaluation, the Doctoral candidate provided a detailed description of research into the composition of plant material consisting of prematurely removed flowers; extracts from these organs constitute a valuable source of substances with anthelmintic activity. These studies have revealed a rich composition of plant material, that can be used in agriculture or the pharmaceutical and cosmetic industries.

5. Conclusion

In conclusion, the reviewed doctoral thesis of Kavana Raj, a PhD student of the Doctoral School of the Warsaw University of Life Sciences, is an interesting and innovative study that uses an extensive research topic. The research objectives set by the PhD student have been achieved. The results obtained are very valuable, especially in terms of the use of appropriate seed material and the cultivation methods for this valuable medicinal plant. The manuscript and scientific publications are carefully written, and the small number of errors does not affect my positive assessment of the formal side of the work. The study shows the PhD student's strong theoretical knowledge and ability to conduct research and scientific work independently.

My opinion of the doctoral dissertation is positive. The author's contribution to its creation was crucial, and the results of this dissertation can be recognized according to the applicable law. The manuscript and publications were prepared reliably and meet the requirements for doctoral dissertations, and thus, the author is worthy of the Doctor of Agricultural Sciences. Altogether, the dissertation fulfils the formal criteria (Prawo o szkolnictwie wyższym i nauce, art. 187. Ustawy z dnia 20 lipca 2018, Dz.U. z 2023 r. poz. 742, z późn. zmianami) and my suggestion to the Council of the Agriculture and Horticulture Discipline at the Warsaw University of Life Sciences (SGGW) is to proceed further with the doctorate procedure.

Ewa Zalewska

