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Research Article

Optimizing Soaking Time for Enhanced Microgreen Growth in Arugula (*Eruca sativa* Mill.)

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Abstract **–**This study explores how different soaking durations influence the germination and growth of arugula (*Eruca sativa* Mill.) microgreens. Known for its rich nutritional profile, distinctive flavor, and numerous health benefits, arugula is a popular choice for microgreen cultivation. In this experiment, we soaked the seeds in water for varying durations ranging from 0 to 72 h before growing them in a vermiculite medium under consistent light and irrigation conditions. The findings revealed that seeds soaked for 0 h exhibited the highest germination rate, maintaining a strong viability of approximately 85% to 90%. When the soaking duration extended to 6, 12, and 18 h, the germination rate showed a slight decline. However, a more pronounced reduction was observed after 24 h, and by 72 h, the germination rate had dropped significantly to around 65%. Beyond germination, the soaking duration also affected microgreen growth. The tallest microgreens, reaching optimal heights, were produced from seeds soaked for 0, 6, and 12 h. In contrast, seeds subjected to the longest soaking time of 72 h resulted in the shortest microgreens. These results suggest that prolonged exposure to water may impose stress on the seeds, as evidenced by the reduced germination rates and shorter microgreen heights observed, ultimately hindering their growth potential. Overall, the study highlights that while short-term soaking (up to 12 h) has little effect on germination or microgreen development, extended soaking times-especially beyond 24 h-can negatively affect both processes. To maximize growth efficiency, soaking arugula seeds within the 0-12 hour range appears to be the most effective approach.

Keywords – Microgreens, Eruca Sativa, Seed Germination, Soaking Time.

I. INTRODUCTION

Plant-based foods contribute significantly to human health due to their rich content of vitamins, minerals, metabolites, and antioxidant properties (Lundegårdh and Mårtensson, 2003; Martínez-Ballesta et al., 2010; Li et al., 2012; Doğan, 2020; Martin and Li, 2017; Göldağ et al., 2022; Erkorkmaz et al., 2023; Kaynak et al., 2024; Chen et al., 2018; Göldağ and Doğan, 2024). Microgreens are nutrient-dense,

flavorful, and visually appealing small plants (Verlinden et al., 2020; Di Gioia et al., 2021; Keutgen et al., 2021; Partap et al., 2023; Sharma et al., 2025; Saha et al., 2025; Gupta et al., 2025). In recent years, increasing health awareness and the growing preference for natural foods have led to a significant rise in interest in microgreens (Zhang et al., 2021; Dubey et al., 2024; Singh et al., 2024). This trend has resulted in greater adoption of microgreens by both professional chefs and home users (Renna et al., 2017; Singh et al., 2024). Microgreens are typically obtained by germinating seeds of vegetables, herbs, or other plants, and their growth process is supported by specialized cultivation techniques (Kyriacou et al., 2016; Verlinden, 2020; Ebert, 2022).

Arugula (*Eruca sativa* Mill.) is notable for its rich nutritional content, strong aroma, and health benefits (Al-Rawe et al., 2023). It contains essential nutrients such as vitamin C, vitamin K, folate, and various antioxidants (Rana and Kumar, 2017; Duru et al., 2022). As a microgreen, arugula is widely used in salads, sandwiches, and garnishes (Komeroski et al., 2024; Krupa et al., 2025).

The growth of microgreens depends on various factors. The primary aim of this study is to determine the effects of seed soaking durations on microgreen production. The findings of this research will provide guidance for ensuring more efficient and healthy growth conditions in arugula microgreens production.

II. MATERIALS AND METHOD

Study Site and Seed Acquisition

This study was carried out in the laboratory of the Biology Department at Karamanoğlu Mehmetbey University (KMU). The arugula seeds used in the research were sourced from certified local suppliers. These seeds were untreated, free from chemical preservatives, and stored at a refrigerator temperature of +4°C.

Growing Medium Preparation

Microgreens were cultivated using vermiculite as the growing medium. To achieve uniform seed distribution, pre-prepared vermiculite containers were used. An equal quantity of seeds was evenly dispersed in each container and gently pressed onto the surface to ensure proper contact.

Seed Pre-Treatment and Experimental Setup

The seeds were subjected to soaking in distilled water under dark conditions for varying time intervals (0, 6, 12, 18, 24, 48, and 72 hours). Following the soaking treatment, the seeds were transferred into vermiculite-filled containers for microgreen cultivation. These containers were positioned under white LED lights with a 550 nm wavelength. To ensure consistent moisture levels, all samples were watered uniformly under controlled conditions. The lighting cycle consisted of 16 hours of illumination followed by 8 hours of darkness. Throughout the experiment, key environmental factors such as irrigation, temperature, and humidity were kept constant.

Data Processing and Statistical Analysis

All experiments were conducted in triplicate. The data collected during the study were analyzed using SPSS software. A one-way analysis of variance (ANOVA) was employed to evaluate differences among the experimental groups. For a detailed comparison of statistically significant results, Duncan's multiple range test was applied. A significance threshold of $p<0.05$ was used for all statistical analyses.

III. RESULTS AND DISCUSSION

Figure 1 illustrates how different soaking durations impact the germination rates of arugula seeds. The x-axis represents soaking durations ranging from 0 to 72 h, while the y-axis indicates the corresponding germination percentages. The highest germination rate, approximately 85-90%, was recorded in seeds that were not soaked at all (0 h). When seeds were soaked for 6, 12, or 18 h, their germination rates remained fairly close to one another, showing only a slight decline compared to the initial rate. However, after 24 h of soaking, a noticeable drop in germination was observed.

As the soaking duration increased further, germination rates continued to decline. Seeds soaked for 48 h exhibited an even greater reduction, while those subjected to 72 h of soaking showed the lowest germination rate, dropping to around 65%. Statistical groupings, indicated by letters on the bars, reveal significant differences among some of the tested durations. Groups marked with the same letter do not significantly differ, whereas those with different letters indicate statistically meaningful variations.

Overall, these results suggest that shorter soaking durations (0-18 h) do not significantly hinder germination, while prolonged exposure to water (24-72 h) negatively affects seed viability. Notably, the 72-hour soaking period had the most detrimental effect, leading to the sharpest decline in germination. This highlights the importance of optimizing soaking time to prevent excessive water exposure, which may compromise seed health and reduce successful sprouting.

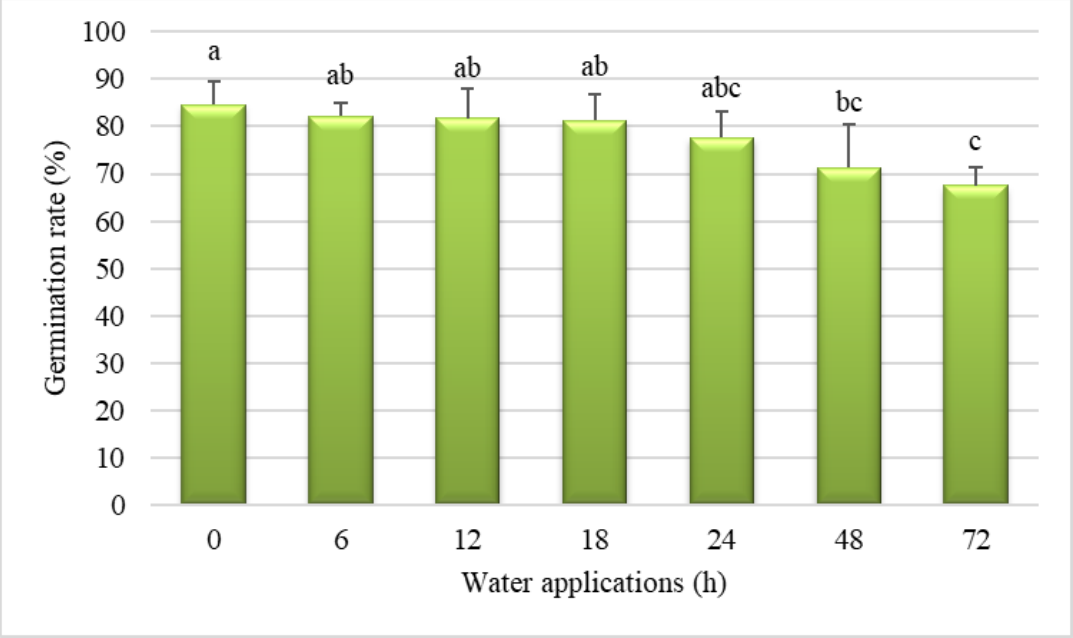

Figure 1. Impact of various soaking times on the germination of arugula seeds

Figure 2 presents the lengths of microgreens cultivated from arugula seeds soaked for varying durations. The longest microgreens, measuring around 4 cm, were obtained from seeds that were soaked for 0, 6, and 12 h, as illustrated in Figure 3. These groups are denoted by the letter "a" on the graph, indicating that there are no statistically significant differences among them.

A slight decrease in length was noted for microgreens derived from seeds soaked for 18 h, which are labeled "ab." Further reductions in microgreen length were seen in those from seeds soaked for 24 h, categorized under "abc." Seeds that soaked for 48 hours produced even shorter microgreens, marked with the letter "bc." The shortest microgreens, measuring approximately 3 cm, came from seeds soaked for 72 h, designated as group "c," highlighting a significant difference from the other groups.

These findings clearly indicate that extended exposure to water has a negative impact on microgreen growth. In particular, seeds soaked for more than 24 hours showed a marked decrease in growth rate. This suggests that excessive water can stress seed development, ultimately hindering growth. Therefore, it is apparent that soaking seeds for 0 to 12 h results in the best outcomes for optimal microgreen production.

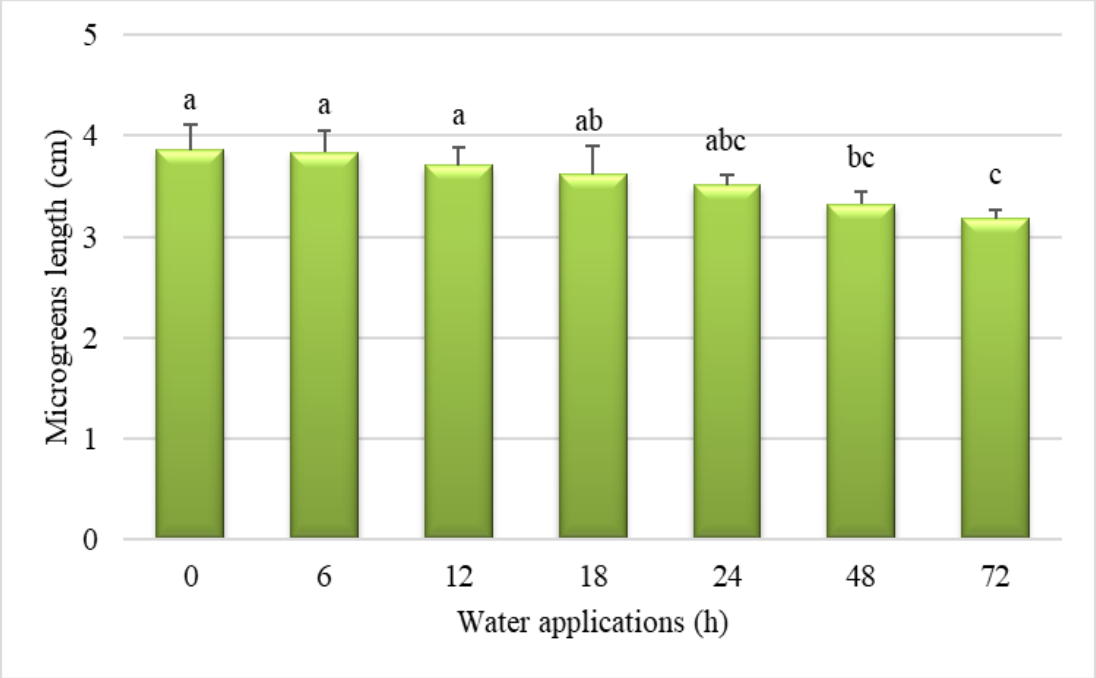

Figure 2. Influence of various soaking durations on the growth of arugula microgreens

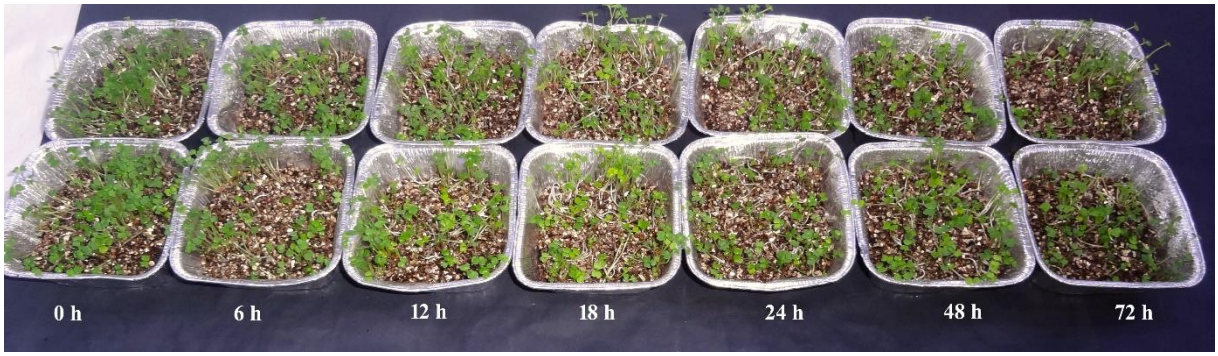

Figure 3. Microgreens produced from arugula seeds soaked for different durations

IV. CONCLUSION

This study highlighted the considerable influence of soaking durations on the germination and growth of arugula microgreens. The results showed that seeds soaked for 0 hours achieved the highest germination rates, hovering around 85-90%. However, longer soaking periods, especially those exceeding 18 hours, led to a significant decrease in germination, with the lowest rate of approximately 65% observed after 72 hours. Moreover, the growth lengths of microgreens varied with the soaking duration. The longest microgreens were obtained from seeds soaked for 0, 6, and 12 hours. These findings clearly indicate that excessive exposure to water can adversely affect both seed germination and microgreen development. In conclusion, the study suggests that the optimal soaking durations for arugula seeds range from 0 to 12 hours to achieve the best results in terms of germination and growth.

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REFERENCES

Al-Rawe, S. D., Al-Farha, A. A. B., & Mohammad, M. A. (2023). The Role of Rocket (Eruca sativa) as Dietary Supplementation to Enhance Fish Nutrition and Health: A Review. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1158, No. 5, p. 052004). IOP Publishing.

Chen, Y., Michalak, M., & Agellon, L. B. (2018). Focus: nutrition and food science: importance of nutrients and nutrient metabolism on human health. *The Yale journal of biology and medicine*, *91*(2), 95.

Di Gioia, F., Petropoulos, S. A., Ferreira, I. C., & Rosskopf, E. N. (2021). Microgreens: from trendy vegetables to functional food and potential nutrition security resource. In *III International Symposium on Soilless Culture and Hydroponics: Innovation and Advanced Technology for Circular Horticulture 1321* (pp. 235-242).

Doğan, M. (2020). Su teresinin (*Nasturtium officinale* R. BR.) beslenme-diyet potansiyeli ve antioksidan özellikleri: bir derleme. *International Anatolia Academic Online Journal Health Sciences*, *6*(3), 222-233.

Dubey, S., Harbourne, N., Harty, M., Hurley, D., & Elliott-Kingston, C. (2024). Microgreens production: exploiting environmental and cultural factors for enhanced agronomical benefits. *Plants*, *13*(18), 2631.

Duru, Ö. A., Araç, F. Ö. Ö., & Aldemir, O. (2022). The Importance of Arugula (Eruca sativa) and Pharmacological Effects of Different Phytochemical Components in Its Content for Human Health. In *Handbook of Research on Advanced Phytochemicals and Plant-Based Drug Discovery* (pp. 327-340). IGI Global.

Ebert, A. W. (2022). Sprouts and microgreens—Novel food sources for healthy diets. *Plants*, *11*(4), 571.

Erkorkmaz, F., Altunbay, M., Demirci, Z., & Doğan, M. (2023). Chia Tohumunun (Salvia hispanica L.) Bileşimi, Besinsel Değeri ve Sağlık Faydaları: Composition, Nutritional Value and Health Benefits of Chia Seed (*Salvia hispanica* L.). *Scientific And Academic Research*, *2*(1), 96-106.

Göldağ, R., & Doğan, M. 2024. Avokado (Persea americana Mill.)'nun Besin içeriği, Antioksidan Özelliği ve Potansiyel Sağlık Faydaları. *Karamanoğlu Mehmetbey Üniversitesi Mühendislik ve Doğa Bilimleri Dergisi*, *6*(1), 44-51.

Göldağ, R., Göldağ, Ö. G., & Doğan, M. (2022). Beslenme ve sağlık için kara mürver'in (Sambucus nigra L.) önemi: biyolojik aktiviteleri. *Academic Platform Journal of Halal Lifestyle*, *4*(1), 10-17.

Gupta, A., Sharma, T., Bhardwaj, V., Shubhamkumar Manojkumar, S., Sanjaykumar, D. Y., Singh, D. V., & Dhulipalla, M. (2025). Microgreens as Budding Medicine and Bountiful Source of Nutrition. In *Recent Trends and Applications of Leguminous Microgreens as Functional Foods* (pp. 579-604). Cham: Springer Nature Switzerland.

Kaynak A, Başkan ZN, Satış B, Doğan M. 2024. Kırmızı pancar (Beta vulgaris L.): Besinsel bileşimi, antioksidan özellikleri ve sağlık faydaları. Eurasian J Bio Chem Sci, 7(1):52-61.

Keutgen, N., Hausknecht, M., Tomaszewska-Sowa, M., & Keutgen, A. J. (2021). Nutritional and sensory quality of two types of cress microgreens depending on the mineral nutrition. *Agronomy*, *11*(6), 1110.

Komeroski, M. R., Beninca, T., Portal, K. A., Malheiros, P. S., Klug, T. V., Flores, S. H., & Rios, A. O. (2024). Postharvest Quality of Arugula (Eruca sativa) Microgreens Determined by Microbiological, Physico-Chemical, and Sensory Parameters. *Foods*, *13*(19), 3020.

Krupa, S., Dalvi, Y. B., Aranganathan, V., & Varghese, R. (2025). Microgreens: A Novel Source of Functional Nutraceuticals. *Recent Trends and Applications of Leguminous Microgreens as Functional Foods*, 87-101.

Kyriacou, M. C., Rouphael, Y., Di Gioia, F., Kyratzis, A., Serio, F., Renna, M., ... & Santamaria, P. (2016). Micro-scale vegetable production and the rise of microgreens. *Trends in food science & technology*, *57*, 103-115.

Li, H., Tsao, R., & Deng, Z. (2012). Factors affecting the antioxidant potential and health benefits of plant foods. *Canadian journal of plant science*, *92*(6), 1101-1111.

Lundegårdh, B., & Mårtensson, A. (2003). Organically Produced Plant Foods-Evidence of Health Benefits. *Acta Agriculturae Scandinavica: Section B, Soil & Plant Science*, *53*(1).

Martin, C., & Li, J. (2017). Medicine is not health care, food is health care: plant metabolic engineering, diet and human health. *New phytologist*, *216*(3), 699-719.

Martínez-Ballesta, M. C., Dominguez-Perles, R., Moreno, D. A., Muries, B., Alcaraz-López, C., Bastías, E., ... & Carvajal, M. J. A. F. S. D. (2010). Minerals in plant food: effect of agricultural practices and role in human health. A review. *Agronomy for sustainable development*, *30*(2), 295-309.

Partap, M., Sharma, D., Deekshith, H. N., Thakur, M., Verma, V., & Bhargava, B. (2023). Microgreen: A tiny plant with superfood potential. *Journal of Functional Foods*, *107*, 105697.

Rana, M. K., & Kumar, S. (2017). Arugula. In *Vegetable Crop Science* (pp. 269-276). CRC Press.

Renna, M., Di Gioia, F., Leoni, B., Mininni, C., & Santamaria, P. (2017). Culinary assessment of self-produced microgreens as basic ingredients in sweet and savory dishes. *Journal of culinary science & technology*, *15*(2), 126-142.

Saha, A., Ghatak, P., Sinha, S., Samanta, S., & Mahanta, S. (2025). Nutritional Profile of Leguminous Microgreens: Seed to Superfood. In *Recent Trends and Applications of Leguminous Microgreens as Functional Foods* (pp. 1-19). Cham: Springer Nature Switzerland.

Sharma, T., Singh, K. P., Chudali, S., Limbu, B. H., & Gupta, A. (2025). Phytochemical and Nutritional Properties of Leguminous Microgreens and Its Application in Food Industry. In *Recent Trends and Applications of Leguminous Microgreens as Functional Foods* (pp. 605-619). Cham: Springer Nature Switzerland.

Singh, A., Singh, J., Kaur, S., Gunjal, M., Kaur, J., Nanda, V., ... & Rasane, P. (2024). Emergence of microgreens as a valuable food, current understanding of their market and consumer perception: A review. *Food Chemistry: X*, 101527.

Verlinden, S. (2020). Microgreens: Definitions, product types, and production practices. *Horticultural reviews*, *47*, 85-124.

Zhang, Y., Xiao, Z., Ager, E., Kong, L., & Tan, L. (2021). Nutritional quality and health benefits of microgreens, a crop of modern agriculture. *Journal of Future Foods*, *1*(1), 58-66.