





Drying Efficiency of Purple and Green Basil (*Ocimum basilicum* L.) at Different Growth Stages with Mycorrhiza and Trichoderma Treatments under Niğde Ecological Conditions

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Abstract. This study evaluated the drying efficiency of green and purple basil (*Ocimum basilicum* L.) varieties at three phenological stages (two weeks before flowering, one week before flowering, and at flowering) under Niğde ecological conditions, incorporating Mycorrhiza and Trichoderma treatments to assess their impact on leaf water loss and overall drying performance. Plants were grown in peat-filled pots, and 1 cm² leaf discs were oven-dried at 80 °C for 48 h. The drying ratio (%) was determined by dividing the dry weight of the leaf samples by their fresh weight and then multiplying the result by 100, and data were analyzed using ANOVA and LSD tests ($p \leq 0.05$). Results revealed that drying efficiency peaked at the flowering stage in both varieties. The highest drying ratio was recorded in purple basil at flowering under control conditions (54.7%), significantly higher than green basil ($p \leq 0.05$). Purple basil also showed a high drying ratio two weeks before flowering (43.5%) in control treatment. Green basil consistently exhibited lower drying ratios, with its highest value under Trichoderma at the earliest stage (26.1%). Mycorrhiza and Trichoderma treatments reduced drying ratios in purple basil but had minimal effect on green basil, indicating varietal differences in treatment responsiveness. At one week before flowering, drying ratios ranged from 22.0% to 31.2% with no significant differences. These findings suggest that purple basil is more suitable for drying-focused processing, particularly when harvested at flowering without biological treatments. For freshness preservation, applying Mycorrhiza or Trichoderma can reduce water loss in purple basil. In contrast, green basil shows more stable but lower drying efficiency across treatments. Overall, integrating growth stage, variety, and microbial treatments is essential for optimizing basil postharvest quality and drying strategies under semi-arid ecological conditions.

Keywords: *Ocimum basilicum*, drying efficiency, growth stage, purple and green basil, postharvest handling

1 Introduction

Basil (*Ocimum basilicum* L.) is a widely cultivated aromatic plant of considerable cultural and economic significance. It is valued globally for its culinary, medicinal, and ornamental uses. Known for its distinctive flavor and aroma, which stem from its rich essential oil content, basil has long been a staple in cuisines across Asia, the Mediterranean, and the Americas [1]. Beyond its role in gastronomy, basil is recognized for a variety of pharmacological properties, including antioxidant, anti-inflammatory, antimicrobial, and anticancer effects, which have been supported by numerous studies [2, 3]. These qualities have encouraged its use in traditional medicine and have attracted growing interest from the nutraceutical and pharmaceutical industries [4]. Another advantage of basil is its ability to adapt to a wide range of climatic conditions and its relatively easy cultivation, factors that enhance its global production and economic relevance [5]. Thus, basil represents not only an important culinary herb but also a valuable source of bioactive compounds with proven health benefits. Drying plays a crucial role in postharvest handling of basil, as it directly impacts both aroma preservation and commercial value. Because the plant is rich in volatile oils, particularly linalool, eugenol, and methyl chavicol, improper drying can cause major losses in both flavor and bioactivity [6]. Drying techniques greatly influence the essential oil content and composition. For instance, shade drying often yields the highest essential oil levels and best preserves aromatic compounds, as the slower dehydration process reduces thermal stress. In contrast, high-temperature methods such as oven or microwave drying may degrade thermolabile compounds like monoterpenes and sesquiterpenes, diminishing both quality and aroma [7, 8]. Drying methods also affect mineral retention. Shade drying typically maintains higher calcium and potassium levels, whereas oven drying may lead to mineral losses [9]. For this reason, low-temperature or shade drying methods are preferred to safeguard both aroma and nutritional value. In particular, air drying at room temperature has proven effective in retaining key aroma compounds such as linalool and eugenol when compared to oven and freeze-drying [10]. Optimizing drying practices is therefore essential to maintain basil's sensory qualities, extend shelf life, and ensure profitability, especially for producers serving export markets or high-value processing industries. This study was conducted to evaluate the drying efficiency of purple and green basil varieties at three growth stages under Niğde's ecological conditions. By comparing drying performance at different developmental phases, the study seeks to determine the most suitable harvest time for maximizing aroma retention and economic value.

2 Material and Methods

2.1 Experimental Site and Conditions

The research was carried out in the experimental field of the Faculty of Agricultural Sciences and Technology, Niğde, Türkiye (37°56'N–34°37'E), under uncontrolled greenhouse conditions during the 2025 growing season. Basil seedlings, one week old,

were transplanted into 2.5 L pots filled with peat soil. Since peat provides sufficient nutrients, no additional fertilization was applied. Plants were watered as needed, roughly twice per week. The trial continued for about a month, ending before the first flowers appeared. Climatic parameters were monitored throughout the experiment to ensure consistency. In July 2025, the average daily temperature in Niğde was 22.5 °C, with maximum and minimum averages of 29.5 °C and 14.6 °C, respectively [11]. Relative humidity averaged 45–46% [12], with total precipitation at 5.5 mm and rainfall occurring on about 1.8 days [11]. Daily sunshine lasted around 11.5 hours [11].

2.2 Plant Material and Growth Stages

Two basil varieties (green and purple) were studied. Samples were taken at three phenological stages: two weeks before flowering, one week before flowering, and at flowering.

2.3 Sampling Method

Leaves were sampled using a standardized 1 cm² leaf disc method. For each variety and growth stage, five replicates were taken. Fresh weights were recorded immediately, after which samples were dried in an oven at 80 °C for 48 hours, and dry weights were measured.

2.4 Calculation of Drying Ratio

The drying ratio, used to assess water loss, was calculated as (dry weight ÷ fresh weight) × 100.

2.5 Statistical Analysis

Data were analysed using analysis of variance (ANOVA) to determine significant differences among varieties, growth stages, and their interactions. Where significant differences were found ($p < 0.05$), Fisher's Least Significant Difference (LSD) test was applied for mean comparisons. Results are reported as means ± standard error (SE), with different letters (e.g., a, b, c) indicating statistically significant differences. Analyses were conducted using IBM SPSS v25.

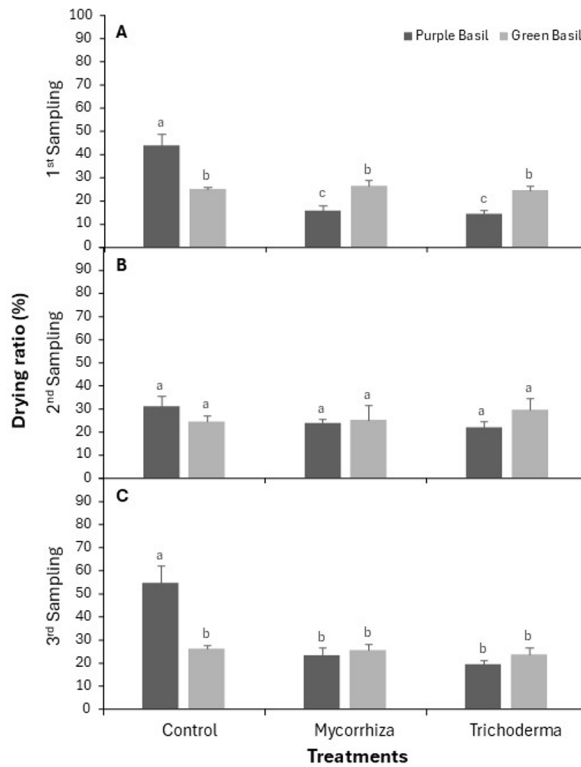


Figure 1. Drying ratio (%) at three sampling physiological stages (two-weeks before flowering, A; one-weeks before flowering, B; flowering, C) in green and purple varieties of basil (*Ocimum basilicum* L.). The various letters represent substantial variations in treatment ($P \leq 0.05$) as per the LSD test ($n = 5$).

3 Results

Drying ratios of green and purple basil were evaluated at three growth stages: two weeks before flowering (A), one week before flowering (B), and at flowering (C), under three treatments: Control, Mycorrhiza, and Trichoderma (Figure 1). At the first sampling (Figure 1A), purple basil under control treatment reached the highest drying ratio (43.5%), significantly higher than all other treatments and the green basil variety ($P \leq 0.05$). Green basil showed lower drying ratios overall, with its highest value under the Trichoderma treatment (26.1%). Both Mycorrhiza and Trichoderma treatments lowered drying ratios in purple basil compared to the control.

At the second sampling (Figure 1B), drying ratios ranged from about 22.0% to 31.2%, with no significant differences among treatments or between varieties.

At the third sampling (Figure 1C), purple basil under control treatment again had the highest drying ratio (54.7%), noticeably higher than all other treatments and the green basil variety ($P \leq 0.05$). Both biological treatments reduced drying ratios in purple basil, while green basil remained relatively stable across treatments.

Overall, control conditions led to higher drying ratios, especially in purple basil. Mycorrhiza and *Trichoderma* reduced water loss in purple basil but had limited effects on green basil.

4 Discussion

The study results reveal clear differences in drying behaviour between green and purple basil across growth stages and treatments. Purple basil consistently had higher drying ratios, particularly two weeks before flowering and at flowering, under control conditions. These differences may be explained by varietal traits such as stomatal density and cuticle thickness, which affect transpiration and water loss [13].

The biological treatments noticeably reduced drying ratios in purple basil, suggesting better water retention. Mycorrhizal fungi are known to enhance root surface area and improve drought tolerance [14]. Similarly, *Trichoderma spp.* contributes to stress tolerance through phytohormone regulation and antioxidant defense mechanisms [15, 16]. These effects likely account for the slower drying observed in purple basil.

Green basil showed little response to these treatments, reflecting differences in varietal responsiveness to symbiotic interactions, consistent with findings in other herbaceous plants [17]. The uniform ratios during the second sampling may reflect a growth phase in which leaf water content stabilizes [18].

Overall, this study highlights the importance of integrating variety-specific traits, physiological stage, and beneficial microbial applications to optimize basil harvest and postharvest drying processes. Future research should focus on elucidating the underlying physiological and molecular mechanisms governing these interactions to better inform cultivation and processing practices.

5 Conclusion

The findings show that drying efficiency peaks at the flowering stage for both basil varieties, with purple basil generally losing water more readily than green basil. This suggests that purple basil may be especially well-suited for drying processes. For producers seeking faster drying and processing, harvesting purple basil at flowering without biological treatments is recommended. In contrast, when the goal is to preserve freshness, applying treatments such as Mycorrhiza or *Trichoderma* can help, particularly for purple basil. For green basil, although drying ratios are lower and less variable, harvesting at flowering still provides advantages. In sum, harvesting basil at flowering ensures optimal drying efficiency and enhances postharvest handling for both green and purple varieties.

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Consent to Participate. Not applicable.

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