



Effect of Drying Duration On The Quality of Shallots

(*Allium Ascalonicum L.*) Bima Variety

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ABSTRACT

Shallot (*Allium ascalonicum L.*) is an important vegetable commodity and an economically valuable crop in Indonesia. One of the important postharvest handling stages for shallots is drying. Drying that is too short may leave the bulbs with high moisture content, which can increase the risk of rotting, sprouting, and fungal infection during storage. Conversely, prolonged drying may increase weight loss. This study was conducted in July 2025 at the storage warehouse area of the Makam Dawa Farmers Group in Ender Village, Pangenan District, Cirebon Regency, and at the Laboratory of the Faculty of Agriculture, Universitas Swadaya Gunung Jati. The experiment used a Completely Randomized Design (CRD) with one factor, namely drying duration, consisting of three levels: P1 = 5 days, P2 = 10 days, and P3 = 15 days. Each treatment was replicated nine times, giving 27 experimental units, with 30 bulbs in each experimental unit. Quality observations were conducted at 20, 25, and 30 days after harvest. The results showed that drying duration significantly affected weight loss, sprouting percentage, and damage percentage, but did not significantly affect bulb firmness or moisture content. P3 (15 days) had the lowest observed sprouting and damage percentages but the highest weight loss. Under the conditions tested, no single drying duration could be identified as superior for all quality parameters.

Keywords: drying, quality, shallot, Bima Variety

1. INTRODUCTION

Shallot (*Allium ascalonicum L.*) is an economically important horticultural commodity in Indonesia and is widely used as a food seasoning. Postharvest handling is important because the quality and storage life of shallot bulbs are strongly affected by drying and storage conditions. Previous studies have examined shallot drying and storage, including sun/in-store drying, controlled drying systems, and different storage conditions (Nugraha et al., 2011; Lestari et al., 2018; Manfaati et al., 2019; Islam et al., 2019; Kiran et al., 2024).

Drying is an important postharvest process because it reduces bulb moisture and helps prepare shallots for storage. Inadequate drying may be associated with higher moisture, sprouting, and postharvest deterioration, whereas prolonged drying can increase weight loss. Studies on shallot and onion curing indicate that drying duration and storage environment influence weight loss, firmness, sprouting, and deterioration (Nugraha et al., 2011; Lestari et al., 2018; Kiura et al., 2021; Suravi et al., 2024). Recent research also indicates that drying and storage responses depend

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on temperature, relative humidity, air movement, cultivar, and maturity stage (Islam et al., 2019; Kiran et al., 2024; Assefa et al., 2026). However, the response of Bima shallots to different durations of sun-drying under farm-level storage conditions requires further characterization. Therefore, this study aimed to evaluate the effect of drying duration on the postharvest quality of Bima shallots based on weight loss, firmness, moisture content, sprouting, and damage during storage.

2. MATERIALS AND METHODS

The research was conducted in July 2025 at the storage warehouse area owned by the Makam Dawa Farmers Group in Ender Village, Pangenan District, Cirebon Regency, and at the Laboratory of the Faculty of Agriculture, Universitas Swadaya Gunung Jati. The equipment included storage paper or plastic, drying racks, an analytical balance, a hygrometer, a drying oven, harvest baskets, plastic shallot baskets, and a thermometer. The material used was shallot bulbs of the Bima variety. After drying treatments, the bulbs were stored under room-temperature conditions. The temperature reported during storage was approximately 28–30°C. Relative humidity, ventilation, and light intensity were not included in the available experimental record and therefore are not reported here.

The experiment was conducted using a Completely Randomized Design (CRD) with one factor, namely drying duration, consisting of three treatment levels:

P1 = 5 days of drying

P2 = 10 days of drying

P3 = 15 days of drying

Each treatment was replicated nine times, resulting in 27 experimental units. Each experimental unit contained 30 shallot bulbs. The experimental unit, rather than the individual bulb, was treated as the unit of replication for statistical analysis; bulbs within an experimental unit were treated as subsamples. Thus, a total of 810 bulbs were used.

When the analysis of variance indicated a significant treatment effect, means were separated using Duncan's Multiple Range Test (DMRT) at the 5% significance level. The statistical procedure followed Wijaya (2009).

Bulbs harvested at 55–60 days after planting and weighing 20–25 g were selected for uniformity. Bulbs with defects, visible damage, pests, or diseases were excluded. The bulbs were carefully cleaned to remove adhering soil and then sun-dried according to the assigned treatment





(5, 10, or 15 days), with periodic turning during drying. After each drying treatment was completed, the bulbs were kept under the storage conditions described above. The observation dates—20, 25, and 30 days after harvest—refer to calendar days after harvest, not days after drying. Consequently, the duration of storage before each observation differed among drying treatments. The variables observed were weight loss, bulb firmness (kg/cm²), moisture content (%), sprouting (%), and damage (%).

Weight Loss Analysis(%)

Weight loss was determined from the difference between initial and final bulb weight using an analytical balance. The same 30 bulbs in each experimental unit were weighed repeatedly at 20, 25, and 30 days after harvest. Individual bulbs were treated as subsamples, and the experimental-unit value was used for treatment-level statistical analysis. The percentage weight loss was calculated as follows:

$$\text{Weight loss (\%)} = [(A - B) / A] \times 100$$

Description:

A = Initial weight

B = Final weight

Shallot Firmness (kg/cm²)

Shallot firmness was measured using a penetrometer based on resistance to probe penetration. The penetrometer was positioned perpendicular to the middle portion of the bulb surface. The value displayed by the instrument was recorded as bulb firmness. Measurements were made at 20, 25, and 30 days after harvest. Two bulbs were sampled from each of the nine experimental units per treatment (18 bulbs per treatment at each observation), and the experimental-unit mean was used as the statistical replicate. Firmness was expressed as kg/cm².

Moisture Content Analysis (%)

Moisture content was determined by the gravimetric oven-drying method at 105°C. Measurements were made at 20, 25, and 30 days after harvest; however, only the day-30 values are presented in Table 3 because day 30 was the final observation point. Moisture content was calculated on a wet basis using the following equation:

$$\text{Moisture content (\%)} = [(W2 - W3) / (W2 - W1)] \times 100$$

Description:

W1: Weight of the empty weighing dish

W2: Weight of the dish + sample before oven drying



W3: Weight of the dish + sample after oven drying

Sprouted Shallots (%)

Sprouted shallot analysis was conducted to determine the percentage of bulbs that developed visible sprouts during storage. The analysis was performed at 30 days after harvest. The sprouting percentage was calculated as follows:

$$\text{Sprouted shallots (\%)} = (\text{Number of sprouted bulbs} / \text{Total bulbs observed}) \times 100$$

Damage (%)

Damage analysis was conducted to determine the percentage of bulbs showing visible postharvest deterioration, including rotting or disease symptoms such as blackish-brown lesions. The analysis was performed at 20, 25, and 30 days after harvest. A bulb was classified as damaged when visible rotting or disease symptoms were present. The damage percentage was calculated as follows:

$$\text{Damage (\%)} = (\text{Number of damaged bulbs} / \text{Total bulbs observed}) \times 100$$

3. RESULTS AND DISCUSSION

Weight Loss

Weight loss is an important postharvest quality parameter of shallots. Loss of water during drying and subsequent storage, together with respiratory losses, contributes to reductions in bulb weight. Studies of shallot drying and storage have documented changes in bulb weight associated with postharvest moisture loss (Nugraha et al., 2011; Mutia, 2019; Mutia et al., 2014; Lestari et al., 2018). In onion bulbs, mass loss during drying and storage can be considered as a combination of transpiration and respiratory losses, and the magnitude is influenced by temperature, relative humidity, and air movement (Islam et al., 2019; Kiran et al., 2024).

Table 1. Effect of Drying Duration on Shallot Weight Loss (%)

No	Treatment	Shallot Weight Loss (%)		
		Day 20 After Harvest	Day 25 After Harvest	Day 30 After Harvest
1	P1 (Drying 5 days)	22.52 a	23.23 a	23.87 a
2	P2 (Drying 10 days)	25.45 b	27.21 b	27.94 b
3	P3 (Drying 15 days)	28.93 c	30.41 c	30.51 c

Note: Mean values followed by the same letter in a column indicate no significant difference according to the DMRT (Duncan Multiple Range Test) at the 5% level.

Statistical analysis showed that drying duration significantly affected shallot weight loss. Table 1 shows a consistent increase in weight loss with increasing drying duration. P3 (15 days) differed significantly from P2 (10 days) and P1 (5 days) at each observation date. P3 had the





highest observed weight loss at 20, 25, and 30 days after harvest, with values of 28.93%, 30.41%, and 30.51%, respectively. The increase in weight loss is consistent with greater water removal during the longer drying treatment and with continued water loss during subsequent storage. Similar postharvest changes in shallot and onion weight have been associated with water loss through transpiration and respiration (Nugraha et al., 2011; Mutia, 2019; Islam et al., 2019; Kiran et al., 2024).

The greater weight loss observed in P3 should be interpreted as a response of the bulbs to the longer drying period, followed by continued physiological water loss during storage. The present data do not allow the separate contributions of drying and storage respiration to be quantified. Therefore, the result is interpreted primarily as a treatment-associated difference in cumulative weight loss over the observation period.

Shallot Firmness (kg/cm²)

Shallot firmness is an important physical quality indicator during postharvest storage. Statistical analysis showed that drying duration did not significantly affect bulb firmness. Although P3 showed numerically higher firmness values than P1 and P2 at days 20, 25, and 30 after harvest, all means within each observation date carried the same DMRT grouping letter. Therefore, the numerical differences among treatments should not be interpreted as a statistically significant treatment effect. Firmness decreased over storage in all treatments, which is consistent with postharvest softening associated with changes in cell-wall structure and tissue turgor. Similar changes in firmness have been reported in stored shallots under different moisture and temperature conditions (Mutia et al., 2014; Mutia, 2019; Lestari et al., 2018).

Table 2. Effect of Drying Duration on Shallot Firmness (kg/cm²)

No	Treatment	Shallot Firmness (kg/cm ²)		
		Day 20 After Harvest	Day 25 After Harvest	Day 30 After Harvest
1	P1 (Drying 5 days)	4.4 a	3.7 a	3.4 a
2	P2 (Drying 10 days)	4.2 a	3.6 a	3.3 a
3	P3 (Drying 15 days)	4.7 a	3.9 a	3.5 a

Note: Mean values followed by the same letter in a column indicate no significant difference according to the DMRT (Duncan Multiple Range Test) at the 5% level.

During storage, the bulbs undergo physiological and biochemical changes that can reduce firmness. Softening is associated with loss of turgor and changes in cell-wall components, including pectin-related changes. In the present study, firmness declined from day 20 to day 30 in all treatments. Because the treatment effect was not significant, these changes are interpreted



primarily as storage-related changes rather than evidence of a significant effect of drying duration. Similar storage-related changes in shallot firmness have been reported under different storage conditions (Mutia et al., 2014; Lestari et al., 2018). The general mechanism of postharvest softening is also consistent with changes in cell-wall components during storage (Winarno, 2008).

The decline in firmness across all treatments indicates that storage duration was associated with progressive softening. The present experiment did not provide evidence that one drying duration produced statistically different firmness from the others. Therefore, firmness should be considered together with the other quality parameters when interpreting the postharvest response.

Moisture Content Analysis (%)

Statistical analysis showed that drying duration did not significantly affect shallot moisture content. The bulbs were stored at room temperature, approximately 28–30°C. Previous work has shown that moisture changes in stored shallots can be affected by storage temperature and initial moisture content (Mutia et al., 2014; Priyantono et al., 2013). Studies of onion curing and storage also indicate that the interaction between drying history and storage environment can influence moisture loss (Lestari et al., 2018; Kiran et al., 2024). Thus, the numerical differences among treatments in the present study should be interpreted descriptively because the treatment effect was not statistically significant.

Table 3. Effect of Drying Duration on Moisture Content (%)

No	Treatment	Moisture Content (%)		
		Day 30 After Harvest		
1	P1 (Drying 5 days)		80.58 a	
2	P2 (Drying 10 days)		80.54 a	
3	P3 (Drying 15 days)		80.51 a	

Note: Mean values followed by the same letter in a column indicate no significant difference according to the DMRT (Duncan Multiple Range Test) at the 5% level.

Table 3 shows that P3 had the numerically lowest moisture content at day 30 after harvest (80.51%), followed by P2 (80.54%) and P1 (80.58%). However, all means had the same DMRT grouping letter, indicating that the differences were not statistically significant. Therefore, the data do not support a statistically significant effect of drying duration on moisture content under the storage conditions used in this study.

Sprouted Shallots (%)

Sprouted shallot analysis was conducted at 30 days after harvest. Statistical analysis showed that drying duration significantly affected sprouting percentage. P2 (10 days) and P3 (15



days) had lower sprouting percentages than P1 (5 days). Because the observation point was defined as 30 days after harvest, the results represent sprouting status at the same calendar time after harvest, although the treatments had different durations of prior drying. The relationship between curing/drying and sprouting is consistent with postharvest onion studies showing that curing and storage conditions can affect dormancy and subsequent sprouting (Kiura et al., 2021; Kiran et al., 2024; Suravi et al., 2024).

Table 4. Effect of Drying Duration on Sprouted Shallots (%)

No	Treatment	Sprouted Shallots (%)		
		Day 30 After Harvest		
1	P1 (Drying 5 days)		4.05 a	
2	P2 (Drying 10 days)		3.67 b	
3	P3 (Drying 15 days)		3.56 b	

Note: Mean values followed by the same letter in a column indicate no significant difference according to the DMRT (Duncan Multiple Range Test) at the 5% level.

P2 and P3 had significantly lower sprouting percentages than P1. The present data show an association between longer drying treatments and lower observed sprouting at day 30 after harvest. However, moisture content did not differ significantly among treatments, so the reduction in sprouting should not be attributed solely to differences in moisture content. The result is more appropriately interpreted as a response associated with the drying treatment under the storage conditions tested.

Statistical analysis showed that drying duration significantly affected shallot damage percentage. Table 5 shows that P3 (15 days) had the lowest observed damage percentage at all observation dates: 0.26% at day 20, 1.05% at day 25, and 1.20% at day 30 after harvest. P3 differed significantly from P1 and P2 at the reported observation dates, whereas P1 showed the highest damage values. These results indicate that, under the tested conditions, the 15-day drying treatment was associated with lower observed damage during storage. Damage included visible rotting and disease symptoms such as blackish-brown lesions. Similar studies have identified rotting and other postharvest deterioration as important causes of onion storage losses and have emphasized the role of curing and storage conditions in reducing deterioration (Nugraha et al., 2011; Kiura et al., 2021; Suravi et al., 2024).

Statistical analysis showed that drying duration significantly affected shallot damage percentage. Table 5 shows that P3 (15 days) had the lowest observed damage percentage at all



observation dates: 0.26% at day 20, 1.05% at day 25, and 1.20% at day 30 after harvest. P3 differed significantly from P1 and P2 at the reported observation dates, whereas P1 showed the highest damage values. These results indicate that, under the tested conditions, the 15-day drying treatment was associated with lower observed damage during storage. Damage included visible rotting and disease symptoms such as blackish-brown lesions.

Table 5. Effect of Drying Duration on Damage (%)

No	Treatment	Damage (%)		
		Day 20 After Harvest	Day 25 After Harvest	Day 30 After Harvest
1	P1 (Drying 5 days)	2.41 a	4.06 a	4.61 a
2	P2 (Drying 10 days)	1.87 b	2.82 b	3.57 b
3	P3 (Drying 15 days)	0.26 c	1.05 bc	1.20 c

Note: Mean values followed by the same letter in a column indicate no significant difference according to the DMRT (Duncan Multiple Range Test) at the 5% level.

The increase in damage during room-temperature storage may be associated with continued physiological deterioration and microbial development under the prevailing environmental conditions. The storage temperature reported in this study was approximately 28–30°C. Because relative humidity and other environmental variables were not consistently reported, the specific contribution of these factors to microbial development cannot be quantified from the present experiment. Recent reviews indicate that elevated temperature and humidity can aggravate onion postharvest losses, while adequate curing and ventilation can reduce deterioration (Kiran et al., 2024; Suravi et al., 2024). The discussion is therefore limited to the observed relationship between drying treatment and damage percentage.

4. CONCLUSION

Drying duration significantly affected weight loss, sprouting percentage, and damage percentage, but did not significantly affect bulb firmness or moisture content. The 15-day drying treatment (P3) showed the lowest observed sprouting and damage percentages but also the highest weight loss. Therefore, under the conditions tested, 15 days of drying cannot be described as universally superior across all quality parameters. The choice of drying duration should depend on the quality attribute prioritized, with a trade-off between lower sprouting/damage and greater weight loss.

**REFERENCES**

- Assefa, F., Yeshiwas, Y., Alemayehu, M., & Adgo, E. (2026). Influence of variety, toppling stage, and storage duration on postharvest quality and shelf life of onion (*Allium cepa* L.) in Bahir Dar Zuria district. *Scientific Reports*, 16, 5248. <https://doi.org/10.1038/s41598-026-35867-x>
- Islam, M. N., Körner, O., Pedersen, J. S., Sørensen, J. N., & Edelenbos, M. (2019). Analyzing quality and modelling mass loss of onions during drying and storage. *Computers and Electronics in Agriculture*, 164, 104865. <https://doi.org/10.1016/j.compag.2019.104865>
- Kiura, I. N., Gichimu, B. M., & Rotich, F. (2021). Visual and keeping quality of stored bulb onions as affected by harvest and postharvest treatments. *International Journal of Agronomy*, 2021, 9969571. <https://doi.org/10.1155/2021/9969571>
- Kiran, P. R., Aradwad, P., Kumar, A. T. V., Nayana, P. N., Ramya, C. S., Sahoo, M., Urhe, S. B., Yadav, R., Kar, A., & Mani, I. (2024). A comprehensive review on recent advances in postharvest treatment, storage, and quality evaluation of onion (*Allium cepa*): Current status, and challenges. *Future Postharvest and Food*, 1(1), 124–157. <https://doi.org/10.1002/fpf2.12009>
- Lestari, S., Sulistyaningsih, E., & Purwantoro, A. (2018). The effect of drying and storage on the quality of shallot (*Allium cepa* L. *Aggregatum* group) bulbs. *Ilmu Pertanian (Agricultural Science)*, 3(3). <https://doi.org/10.22146/ipas.34203>
- Manfaati, R., Baskoro, H., & Rifai, M. M. (2019). Pengaruh waktu dan suhu terhadap proses pengeringan bawang merah menggunakan tray dryer. *Fluida*, 12(2), 43–49. <https://doi.org/10.35313/fluida.v12i2.1596>
- Mutia, A. K. (2019). Pengaruh kadar air awal pada bawang merah (*Allium ascalonicum* L.) terhadap susut bobot dan tingkat kekerasan selama penyimpanan pada suhu rendah. *Gorontalo Agriculture Technology Journal*, 2(1), 30–37. <https://doi.org/10.32662/gatj.v2i1.538>
- Mutia, A. K., Purwanto, Y. A., & Pujantoro, L. (2014). Perubahan kualitas bawang merah (*Allium ascalonicum* L.) selama penyimpanan pada tingkat kadar air dan suhu yang berbeda. *Jurnal Penelitian Pascapanen Pertanian*, 11(2), 108–115. <https://doi.org/10.21082/jpasca.v11n2.2014.108-115>
- Nugraha, S., Adiandri, R. S., & Yulianingsih. (2011). Pelayuan dan pengeringan bawang merah menggunakan instore drying untuk mempertahankan mutu dan mengurangi tingkat kerusakan. *Jurnal Penelitian Pascapanen Pertanian*, 8(2), 72–81. <https://doi.org/10.21082/jpasca.v8n2.2011.72-81>
- Pradana, A. T. H., Rajiman, R., & Fauziah, N. O. (2025). Pengaruh model pengeringan dan penyimpanan umbi benih terhadap produksi dan mutu bawang merah (*Allium ascalonicum*





- L.) di lahan pasir. Jurnal Agroteknologi, 4(2), 122–131.
<https://doi.org/10.53863/agronu.v4i02.1627>
- Priyantono, E., Ete, A., & Adrianon. (2013). Vigor daya simpan umbi bawang merah (*Allium ascalonicum* L.) varietas Palasa dan Lembah Palu terhadap berbagai kondisi simpan. Agrotekbis, 1(1), 8–16.
- Purwanto, Y. A., & Nugraha, R. B. (2017). Effect of low temperature storage on the postharvest quality of minimally processed shallot (*Allium ascalonicum* L.). Acta Horticulturae, 1152, 137–141. <https://doi.org/10.17660/ActaHortic.2017.1152.19>
- Suravi, T. I., Hasan, M. K., Jahan, I., Shopan, J., Saha, M., Debnath, B., & Ahammed, G. J. (2024). An update on post-harvest losses of onion and employed strategies for remedy. Scientia Horticulturae, 338, 113794. <https://doi.org/10.1016/j.scienta.2024.113794>
- Winarno, F. G. (2008). Kimia pangan dan gizi. Jakarta: Gramedia Pustaka Utama.
- Wijaya. (2009). Rancangan percobaan – RAL dan RAK. Universitas Swadaya Gunung Jati.
- Badan Standardisasi Nasional. (2024). SNI 9289:2024: Bawang merah—Pedoman pascapanen. Jakarta: BSN.