Contemporary Agriculture, 0(0): xx-xx, 2026. AoP
DOI: https://doi.org/10.2478/contagri-2026-0014
eISSN 2466-4774; ISSN 0350-1205

Research article

Influence of Temperature on the Storage Duration of Cabbage (*Brassica oleracea* var. *capitata*)

Siniša Kasić [1], Ivana Tošić [*2], Janko Červenski [3]

[1] Faculty of Agriculture, University of Banja Luka, Bulevar vojvode Petra Bojovića 1A, 78000 Banja Luka, Republic of Srpska, Bosnia and Herzegovina
[2] Agricultural Institute of Republic of Srpska, Banja Luka, Knjaza Miloša 17, 78000 Banja Luka, Republic of Srpska, Bosnia and Herzegovina
[3] Institute of Field and Vegetable Crops, Maksima Gorkog 30, 21000 Novi Sad, Republic of Serbia
**Corresponding author*: it.tosic@gmail.com

Submitted: 27.4.2026.
Reviewed: 17.8.2026.
Accepted: 23.9.2026.

ABSTRACT

This study investigated the postharvest storage performance of three commercial head cabbage hybrids (Bravo F1, Excalibur F1 and Discos F1) and one open-pollinated cultivar (Varaždinski) under three storage temperature regimes (2°C, 4°C and 7°C) at a constant relative air humidity of 90%. The experiment was conducted using a two-factor factorial design, with genotype and storage temperature as the main factors, and each treatment replicated eight times (96 experimental units in total). Storage duration, defined as the number of days from the beginning of storage until the cabbage head no longer met market quality standards, was used as the primary evaluation parameter. Two-way analysis of variance (ANOVA) revealed highly significant effects of genotype ($F = 1148.15$), storage temperature ($F = 542.74$) and their interaction ($F = 83.29$) on storage longevity. Genotype accounted for the largest share of the total treatment variation (approximately 67%), confirming the dominant role of genetic background in determining postharvest performance. Bravo F1 and Excalibur F1 achieved the longest storage durations under optimal low-temperature conditions (99.5 and 98.7 days at 2°C, respectively), while Discos F1 showed the shortest and most temperature-sensitive storage life. The Varaždinski cultivar demonstrated notable stability at moderately elevated temperatures. These results highlight the necessity of combining appropriate genotype selection with precise cold-storage management to maximize postharvest quality and minimize economic losses in commercial cabbage production.

Key words:
genotype, postharvest storage, temperature regimes, quality

Citation:
Kasić, S., Tošić, I. & Červenski, J. 2026. Influence of Temperature on the Storage Duration of Cabbage (*Brassica oleracea* var. *capitata*). *Contemporary Agriculture*, 0(0): xx-xx. https://doi.org/10.2478/contagri-2026-0014

INTRODUCTION

Cabbage (*Brassica oleracea* var. *capitata*) belongs to the Cruciferae family and is characterized by its compact head, which is formed of folded leaves. The world's annual consumption of cabbage is about 70.8 million tons produced on 2.4 million hectares (FAOSTAT, 2020). In Bosnia and Herzegovina, cabbage was grown on 2561 ha with an average yield of 33.98 t/ha (Agency for Statistics of Bosnia and Herzegovina, 2021). Cabbage growth and development at all stages of production are strongly influenced by temperature, with optimal temperatures promoting favorable growth (Rashid et al., 2020; Červenski and Medić-Pap, 2018; Porter et al., 2003). Each cultivar and hybrid of this vegetable shows distinct characteristics during cultivation, harvesting and post-harvest processes. The

© 2026 Author(s). This is an open access article licensed under the Creative Commons Attribution 4.0 International License (https://creativecommons.org/licenses/by/4.0/).

economic returns from cabbage production are reduced if harvesting is not carried out in accordance with the requirements of the particular cultivar or hybrid, as this can affect head quality and subsequent storage potential. To prevent wilting and reduce quality loss, cabbage should be cooled immediately after harvest. Post-harvest storage conditions directly determine shelf life, quality and economic performance, while temperature and humidity are the key factors affecting storage outcomes. The storage life of early-maturity varieties is less than 6 weeks, while late-maturing varieties can be stored for up to 24 weeks (Wennberg et al., 2003). To ensure a year-round supply of cabbage, it is necessary to store it for up to six months at low temperatures and high humidity (Wang, 2002). The main prerequisite for long storage of cabbage is careful harvesting (Nai et al., 2021; Červenski et al., 2010). In order to extend shelf life and maintain good quality, it is necessary to select cultivars that have inherently favorable quality characteristics and extended storage potential. Late-maturing cultivars are used for long-term sweetening of cabbage (Suojala, 2003). Storage at low temperatures significantly extends the shelf life of cabbage (Andernach et al., 2024; Min et al., 2021; Kramchote et al., 2012). Differences in head compactness, dry matter content, leaf structure and metabolic activity significantly affect storage potential (Golian et al., 2023; Schouten, 2004). The aim of the study is to evaluate the impact of different hybrids and varieties as well as storage temperatures on improving cabbage quality during storage.

MATERIAL AND METHODS

The study was conducted using three commercial cabbage hybrids: Bravo F1 (Clause), Excalibur F1 (Beyo Zaden) and Discos F1 (ZKI), as well as the traditional cultivar Varaždinski cabbage (Royal Seeds). These genotypes were selected based on their commercial relevance and expected differences in storage performance. Cabbage was produced on a private farm located in Maglajani, Municipality of Laktaši, Bosnia and Herzegovina. The soil was classified as Eutric Cambisol (FAO, 2021). Before setting up the experiment, the standard soil properties were analyzed (Table 1).

Table 1. Results of agrochemical analysis of soil

Location	Depth (cm)	pH in H_2O	pH in KCl	Humus (%)	P_2O_5 mg 100 g^{-1}	K_2O mg 100 g^{-1}
Maglajani, Laktaši	0-30	6.4	6.1	5.3	14.4	25.6

The experiment was set up in an open field using a randomized block system with four replications. Cabbage was sown in styrofoam containers intended for production of seedlings in the first decade of May. Cabbage was planted in mid-July. Each basic plot measured 3.5 × 5 m, and the planting spacing was 70 x 40 cm. Cultivation practices were performed following standard agrotechnical recommendations for cabbage production, including soil preparation, fertilization, irrigation, plant protection and harvesting at technological maturity. Uniform agronomic practices were applied to ensure that postharvest differences could be attributed primarily to genotype and storage temperature rather than field-related variability. After harvest, healthy and uniform cabbage heads were selected and transported to storage facilities. The experiment was conducted under three temperature regimes (2°C, 4°C and 7°C), with a constant relative air humidity of 90%. Basic fertilization was performed before planting with NPK fertilizer (formulation 15:15:15) at a rate of 300 kg ha^{-1}. The first feeding was applied using urea fertilizer at a rate of 200 kg ha^{-1}, followed by a second application of KAN fertilizer at a rate of 200 kg ha^{-1} during the period of intensive leaf growth. During the growing season, protective agents were applied to control weeds (Zanat at 5 l ha^{-1} before planting and Rafal 120 at 1.2 l ha^{-1} during the period of intensive cabbage growth), to control fleas, bugs and leafhoppers (Talstar at 0.2 l ha^{-1} after planting, during rosette formation and head development) and to control the cause of downy mildew (Mankogal 80 at 2 kg l ha^{-1} after planting). Each storage facility was maintained at one of the three predefined temperature regimes. Relative humidity was kept constant across all treatments to minimize water loss variability and ensure that temperature remained the primary experimental factor. The experiment was arranged as a two-factor factorial design with the following factors:

- Factor A – Genotype (Bravo F1, Excalibur F1, Discos F1 and Varaždinski);
- Factor B – Storage temperature (3 levels: 2°C, 4°C and 7°C).

The total number of experimental units was 96 (4 genotypes × 3 temperatures × 8 replications). The harvest was carried out at the stage of technological maturity in the first decade of October. The primary evaluation parameter was storage duration (days), defined as the number of days from the beginning of storage until the cabbage head no

longer met market quality standards because of visible decay, excessive weight loss, leaf softening or physiological disorders.

The humus content in the soil was determined using a colorimetric method (Resulović et al., 1982) (SRPS ISO 14235: 2005). Soil pH value was measured potentiometrically using "METREL" MA 3657 pH meter in soil suspension prepared with water and soil suspension with 1 M KCl (ratio 1:2.5) (SRPS ISO 10390: 2007). The K_2O content was determined by flame emission photometry, while P_2O_5 was determined spectrophotometrically after color development with ammonium molybdate and SnCl2.

Statistical Analysis

Descriptive statistical parameters (mean, standard deviation, coefficient of variation) were calculated for each genotype × temperature combination. A two-way analysis of variance (ANOVA) was performed to determine the effects of genotype (A), temperature (B) and their interaction (A × B) on storage duration. The significance of differences among treatments was evaluated using the F-test at probability levels of 0.05 and 0.01.

RESULTS AND DISCUSSION

The storage duration of cabbage heads was evaluated under three temperature regimes (2°C, 4°C and 7°C) for three hybrids (Discos F1, Bravo F1 and Excalibur F1) and one open-pollinated cultivar, Varaždinski (Table 2). Descriptive statistical parameters, including mean values, standard deviation (SD) and coefficient of variation (CV%), were calculated for each genotype × temperature combination.

Table 2. Storage duration (days) of four cabbage genotypes under three temperature regimes

Replication	**Temperature**											
	2°C				4°C				7°C			
	Discos F1	Bravo F1	Excalibur F1	Varaždinski	Discos F1	Bravo F1	Excalibur F1	Varaždinski	Discos F1	Bravo F1	Excalibur F1	Varaždinski
1	60	99	99	73	48	60	60	48	34	48	48	48
2	58	105	100	77	50	65	58	50	30	48	46	54
3	55	100	100	70	48	63	58	50	38	48	46	50
4	60	102	95	70	47	65	55	50	38	45	48	50
5	60	100	98	68	47	58	62	48	34	50	48	46
6	64	94	98	75	50	55	63	47	34	52	50	46
7	64	94	98	75	52	60	58	48	36	44	50	46
8	60	102	102	73	48	60	62	48	32	50	50	50

The total sum of squares was 36,830.6, of which genotype accounted for 24,808.2, temperature for 7,818.0 and the genotype × temperature interaction for 3,599.4, while the residual error was 605.0. The F- values obtained for genotype (F = 1148.15), temperature (F = 542.74) and their interaction (F = 83.29) greatly exceeded the corresponding tabulated F-values at both 0.05 and 0.01 probability levels (Figure 1).

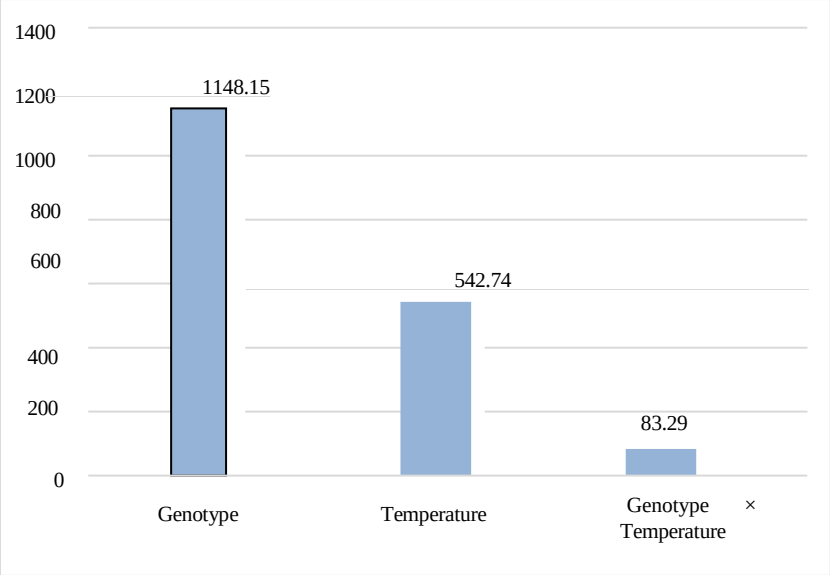


Figure 1. F-values from the analysis of variance (ANOVA) for the main effects and their interaction

These results confirm that cabbage storage longevity is strongly dependent not only on temperature regime but also on genetic background, as well as the genotype-specific response to temperature conditions. A comparison of mean storage durations across the three temperature regimes revealed substantial differences among the tested genotypes (Table 3).

Table 3. Descriptive statistical parameters of storage duration (days) for cabbage genotypes at different storage temperatures

Temperature	Genotype	Sum	Sum of Squares	Mean	Standard Deviation	Coefficient of Variation (%)
2°C	Discos F1	481	28981	60.13	2.95	4.90
	Bravo F1	796	79306	99.50	3.85	3.87
	Excalibur F1	790	78042	98.75	2.05	2.08
	Varaždinski	581	42261	72.63	3.07	4.22
4°C	Discos F1	390	19034	48.75	1.75	3.59
	Bravo F1	486	29608	60.75	3.45	5.69
	Excalibur F1	476	28374	59.50	2.73	4.58
	Varaždinski	389	18925	48.63	1.19	2.44
7°C	Discos F1	276	9576	34.50	2.78	8.05
	Bravo F1	385	18577	48.13	2.64	5.49
	Excalibur F1	386	18644	48.25	1.67	3.46
	Varaždinski	390	19068	48.75	2.82	5.78

The hybrid Bravo F1 showed the longest overall storage duration (with mean values of 99.5 days at 2°C, 60.7 days at 4°C and 48.1 days at 7°C), closely followed by Excalibur F1 (98.7, 59.5 and 48.2 days, respectively). The traditional cultivar Varaždinski demonstrated moderate storage capacity (72.6, 48.6 and 48.7 days), whereas Discos F1 exhibited the shortest storage life across all temperature regimes (60.1, 48.7 and 34.5 days). The magnitude of variation attributable to genotype (SS = 24,808.19) indicates that genetic factors play a dominant role in determining postharvest longevity (Table 4). This finding is consistent with previous postharvest studies reporting that differences in head compactness, dry matter content, leaf structure and metabolic activity significantly influence storage potential (El-Ramady et al., 2015; Eum et al., 2013).

Table 4. Partitioning of treatment sum of squares for genotype, temperature and their interaction

Source of Variation	Sum of Squares
Genotype (Hybrids/cultivar)	24,808.19
Temperature	7,818.04
Genotype × Temperature Interaction	3,599.40

Storage temperature is a crucial factor influencing the postharvest longevity of cabbage (Zainal and Agustoria, 2026; Turner et al., 2020). Hybrids such as Bravo F1 and Excalibur F1 likely possess enhanced structural integrity and reduced respiration rates, which contribute to prolonged shelf life under low-temperature storage. Storage temperature significantly affected cabbage longevity (Liu et al., 2023; Osher et al., 2018; Chen et al., 2012), with a clear decreasing trend as temperature increased. Shim et al. (2016) reported significant variations in cabbage quality indicators depending on the cultivar, storage methods and storage conditions. At 2°C, all genotypes achieved their maximum storage duration. At 4°C, storage life was markedly reduced, while at 7°C a further decline was observed, particularly for Discos F1. The temperature effect (SS = 7,818.0; F = 542) demonstrates that low storage temperature is a critical factor for maintaining cabbage quality. Storage at low temperatures leads to a decrease in quality (Cai et al., 2025; Li et al., 2022). Zhang et al. (2013) reported that long-term storage of cabbage can lead to a decrease in phenolic content. Physiologically, higher storage temperature accelerates respiration rate, ethylene sensitivity, water loss and microbial activity, leading to faster senescence and tissue degradation. Even moderate increases from 2°C to 4°C caused a substantial reduction in storage duration, highlighting the narrow optimal temperature range required for prolonged storage of *Brassica* crops. Similar effects of storage conditions on cabbage quality have been reported by Eum et al. (2013). The coefficient of variation values were relatively low across treatments (generally below 8%), indicating good experimental precision and reliability of the obtained results. The interaction between genotype and temperature was also highly significant (SS = 3,599.4; F = 83.29), indicating that the genotypes responded differently to changes in storage temperature. This interaction is particularly evident when comparing Discos F1 and Varaždinski at 7°C: while Discos F1 experienced a pronounced reduction in storage life (34.5 days), Varaždinski maintained relatively stable values (48.7 days), similar to those recorded at 4°C (Table 5).

Table 5. Mean storage duration (days) of cabbage genotypes as affected by storage temperature

Genotype	Temperature		
	2°C	4°C	7°C
Discos F1	60.1	48.7	34.5
Bravo F1	99.5	60.7	48.1
Excalibur F1	98.7	59.5	48.2
Varaždinski	72.6	48.6	48.7

In contrast, Bravo F1 and Excalibur F1 showed excellent storage performance at 2°C but a substantial reduction in storage duration at higher temperatures, suggesting that their superior storage potential is highly dependent on strict low-temperature conditions. The significant interaction effect demonstrates that storage recommendations should not be generalized across genotypes. Instead, optimal storage strategies should account for specific hybrid responses. From a practical standpoint, hybrids with stable storage performance across temperature regimes may be more suitable for less controlled storage systems. The dominance of genotype in total variation (approximately 67% of explained treatment variation) suggests that breeding for extended storage life remains a key strategy for improving postharvest performance. Respiration rate, weight loss and ethylene production are reduced under low-temperature storage conditions (Kramchote et al., 2012). However, temperature management remains an equally critical technological factor. The quality of cabbage did not deteriorate during 6-7 months under optimal storage conditions. Similar results were reported by Ivanova et al. (2022), Sujatha et al. (2014) and Suojala (2003). At 2°C, cabbage heads maintained significantly longer storage duration, due to reduced metabolic activity and slower degradation processes. At 7°C, accelerated physiological aging may have resulted from higher respiration and transpiration rates, contributing to weight loss and tissue softening. The storage temperature of 2°C provided the longest storage duration among the temperatures evaluated, in agreement with the findings of Yusoff et al. (2023). Bravo F1 and Excalibur F1 demonstrated superior storage performance under optimal low-temperature conditions, while Varaždinski cultivar showed greater stability at moderately elevated temperatures. Discos F1 exhibited the greatest sensitivity to increasing storage temperature. The highly significant effects of genotype, temperature and their interaction confirm that cabbage storage longevity is a multifactorial trait influenced by both genetic and environmental factors. While genetic potential determines baseline storage capacity, temperature management

critically influences the extent to which this potential is maintained under postharvest conditions. These findings emphasize the necessity of integrating genotype selection with precise cold-storage management in order to maximize postharvest quality and minimize economic losses in cabbage production systems.

CONCLUSION

The results clearly indicate that 2°C is the optimal storage temperature for maximizing postharvest life of cabbage, particularly for high-performing hybrids. Even a modest increase to 4°C or 7°C substantially shortened storage duration, with the effect being especially pronounced in temperature-sensitive genotypes. Integrating the selection of superior hybrids (Bravo F1 and Excalibur F1) with strict cold-chain management offers the most effective approach to extending cabbage storage life, minimizing quality deterioration and reducing postharvest losses in commercial production and supply chains.

Authors' Contribution: Conceptualization – K.S.; Data curation – K.S.; Formal analysis – K.S. and T.I.; Investigation – K.S; Methodology – K.S., T.I and Č.J.; Supervision – K.S., T.I. and Č.J.; Visualization - K.S.; Writing – original draft - K.S. an T.I; Writing – review & editing - K.S., T.I. and Č.J. All authors have read and agreed to the published version of the manuscript.

Authors' ORCID iDs: Ivana Tošić (https://orcid.org/0009-0002-9671-7526); Janko Červenski (https://orcid.org/0000-0002-8627-8569)

Conflict of interest: The authors declare that they have no conflict of interest.

REFERENCES

Agency for statistics of Bosnia and Herzegovina. 2021. Survey on agricultural production – crops production (SAP/C). https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://bhas.gov.ba/data/Publikacije/Saopstenja/2021/AGR_22_2020_Y1_0_BS.pdf&ved=2ahUKEwjeiK60f6TAxUl0wIHHX_DNl4QFnoECBYQAQ&usg=AOvVaw24s6FLb5LkJ-30gLUFB6b5

Andernach, L., Witzel, K. & Hanschen, F.S. 2024. Effect of long-term storage on glucosinolate and S-methyl-l-cysteine sulfoxide hydrolysis in cabbage (*Brassica oleracea* var. *capitata*), *Food Chemistry*, 430: 136969. https://doi.org/10.1016/j.foodchem.2023.136969.b

Cai, J., Ren, Q., Liu, S., Wang, X., Zhang, C., Mei, K. & Cheng, X. 2025. Phase change composite materials of sodium alginate-SiO2 aerogel loaded with sodium sulfate decahydrate for cementing of natural gas hydrate layers. *Chemical Engineering Journal*, 505. https://doi.org/10.1016/j.cej.2025.159344

Chen, W.L., Hsiao, C.H., Chen, Y.C. & Chen, Y.W. 2012. Effect of variety, position, fertilizer quantity and low temperature storage on the antioxidant activity of cabbages. *Acta Horticulture*, 939: 209–216. 10.17660/ActaHortic.2012.939.27

Červenski, J., Gvozdenović, Đ., Vlahović, B., Bošnjak, Đ. & Vračar, Lj. 2010. Cabbage harvest and storage. *Field and Vegetable Crops Research*, 47(1): 357-362.

Červenski, J. & Medić-Pap, S. 2018. Proizvodnja kupusa [Cabbage Production]. Institute of Field and Vegetable Crops, Novi Sad.

El-Ramady, H.R., Domokos-Szabolcsy, E., Abdalla, N. & Taha, H. 2015. Postharvest Management of Fruits and Vegetables Storage. *Sustainable Agriculture Reviews*, 65-152. https://doi.org/10.1007/978-3-319-09132-7_2

Eum, H.L., Kim, B.S., Yan, Y.J. & Hong, S.J. 2013. Quality evaluation and optimization of storage temperature with eight cultivars of Kimchi cabbage produced in summer at highland areas. *Korean Journal of Horticultural Science and Technology*, 31(2): 211-218. https://doi.org/10.7235/hort.2013.12170

FAO. 2021. Food and Agriculture Organization of the United Nations. Plant nutrition for food security http://www.fao.org/3/a-a0443e.pdf

FAOSTAT. 2020. Food and Agriculture Organization of the United Nations. Retrieved September 29, https://www.fao.org/faostat/

Golian, J., Anyszka, Z., Kosson, R. & Grzegorzewska, M. 2023. The yield and postharvest quality of Chinese cabbage, depending on weed management method. *Journal of Plant Protection Research*, 63(1): 113-121. https://doi.org/10.24425/jppr.2023.144507

Ivanova, M.I., Yanchenko, E.V., Yanchenko, A.V. & Virchenko, I.I. 2022. Quality and Optimal Shelf Life of Late Season Green Cabbage. *Food Processing Techniques and Technology*, 51(4): 690-700. http://doi.org/10.21603/2074-9414-2021-4-690-700

Kramchote, S., Srilaong, V., Wongs-Aree, C. & Kanlayanarat, S. 2012. Nutritional quality differences of leaves in a cabbage head. *Acta Horticulturae*, 943: 181-186. https://doi.org/10.17660/ActaHortic.2012.943.22

Li, Y.M., Sun, M.H., Tang, X.S., Wang, C.P. & Xie, Z.S. 2022. Genome-wide identification and expression analysis of senescence associated genes in grapevine (*Vitis vinifera L.*) reveal their potential functions in leaf senescence order. *International Journal of Molecular Sciences*, 23: 12731. https://doi.org/10.3390/ijms232112731

Liu, J.Y., Liu, C.W., Chen, W.L., Hsu, M.C., Lin, H.L. & Chen, C.L. 2023. Extending Shelf Life of Cabbage (*Brassica oleracea* cv. K-Y Cross) by Using Vacuum Precooling and Modified Atmosphere Packaging. *Horticulturae*, 9(10): 1096.

https://doi.org/10.3390/horticulturae9101096
Min, S., Jeon, J. & Han, E.S. 2021. Effects of Cooling Rate on Quality Characteristics of Spring Kimchi Cabbage (*Brassica campestris* L. ssp. *Pekinensis*) During Cold Storage. *Food Engineering Progress*, 25: 102-109. https://doi.org/10.13050/foodengprog.2021.25.2.102
Nai, R., Borarin, B., Socheath, T., Vipham, J.L., Young, G.M. & LeGrand, K. 2021. Development of Cold-Chain for Postharvest Loss Reduction of Chinese Cabbage (*Brassica campestris* L. ssp. *Pekinensis*). *Journal of Food Science and Engineering*, 11: 9-22. https://doi.org/10.17265/2159-5828/2021.01.002
Osher, Y., Chalupowicz, D., Maurer, D., Ovadia-Sadeh, A., Lurie, S., Fallik, E. & Kenigsbuch, D. 2018. Summer storage of cabbage. *Postharvest Biology Technology*, 145: 144–150. https://doi.org/10.1016/j.postharvbio.2018.07.006
Porter, K.L., Klieber, A. & Collins, G. 2003. Chilling injury limits low temperature storage of 'Yuki'Chinese cabbage. *Postharvest Biology and Technology*, 28: 153-158. https://doi.org/10.1016/S0925-5214(02)00144-8
Rashid, I., Peer, Q.J.A., Saraf, S.A., Farooq, F. & Aziz, T. 2020. Assessment of the Knowledge Level of Cabbage Growers for an Enhanced Production Technology. *Current Journal of Applied Science and Technology*, 39(15): 36-42. https://doi.org/10.9734/cjast/2020/v39i1530714
Resulović, H., Jovandić, P. & Bisić-Hajro, Dž. 1982. *Mali pedološki priručnik* [*A small pedological manual*]. Poljoprivredni fakultet, Univerzitet Sarajevo [Faculty of Agriculture, University of Sarajevo, Sarajevo].
Schouten, R.E. 2004. Genetic and physiological factors affecting colour and firmness In: Schouten RE, van Kooten O, Jalink H, Kappers IF, Snel JFH, Jordi W. Understanding and Measuring the Shelf-Life of Food, 69. Wageningen University, Plant Research International: The Netherlands.
Shim, J.Y., Kim, D.G., Kandpal, L.M., Hong, S., Cho, B.K. & Lee, W.H. 2016. Physicochemical Quality Changes in Chinese Cabbage with Storage Period and Temperature: A Review. *Journal of Biosystems Engineering*, 41(4): 373-388. https://doi.org/10.5307/JBE.2016.41.4.373
Sujatha, V., Chaturvedi, A. & Manjula, K. 2014. Storage stability of intermediate moisture cauliflower *Brassica oleracea*, var, *botrytis*, cabbage *Brassica oleracea*, var, *capitata* using radiation as hurdle technology. *Journal of Food Technology Research*, 1(1): 60-72. https://doi.org/10.18488/journal.58/2014.1.1/58.1.60.72
Suojala, T. 2003. Compositional and quality changes in white cabbage during harvest period and storage. *Journal Horticulturae Science Biotechnology*, 78: 821–827. https://doi.org/10.1080/14620316.2003.11511704
Turner, E.R., Luo, Y. & Buchanan, R.L. 2020. Microgreen nutrition, food safety, and shelf life: A review. *Journal of Food Science*, 85: 870–882. https://doi.org/10.1111/1750-3841.15049
Wang, C.Y. 2002. Postharvest physiology and pathology of vegetables in Postharvest Physiology and Pathology of Vegetables, 2nd Ed., eds Bartz J. A., Brecht J. K., Cambridge, MA: CRC Press.
Wennberg, M.S., Engqvist, G.M., Nyman, E.M.G.L. 2003. Effects of boiling on dietary fiber components in fresh and stored white cabbage (*Brassica oleracea* var. *capitata*). *Journal of Food Science*, 68(5): 1615-1621. https://doi.org/10.1111/j.1365-2621.2003.tb12301.x
Yusoff, N.H.A., Saat, N.H.M., Yusof, S., Azmi, S.N.R. & Tajuddin, A.K. 2023. Storage at low temperature maintains postharvest quality of lowland chinese cabbage. *International Journal of Agriculture, Forestry and Plantation*, 13: 1-4.
Zainal P.W. & Agustoria, K. 2026. Freshness Identification in Stored Fresh-Cut Cabbage Based on Physicochemical and Sensory Indicators. *Jurnal Keteknikan Pertanian*, 14(2): 245-257. https://doi.org/10.19028/jtep.014.2.245-257.
Zhang, L.P., Xie, J., Wang, T. & Xiong, Q. 2013. Study of Physicochemical Properties of Chinese Small Cabbage (*Brassica chinensis* L.) Stored at Four Temperatures. *Advanced Materials Research*, 690: 1275-1281. https://doi.org/10.4028/www.scientific.net/AMR.690-693.1275

Disclaimer: The views expressed in the published works do not express the views of the Editors and Editorial Staff. The authors take legal and moral responsibility for the ideas expressed in the articles. The publisher shall have no liability in the event of issuance of any claims for damages. The Publisher will not be held legally responsible should there be any claims for compensation.