



Effects of Microwave-Assisted Drying on Drying Behavior, Energy Efficiency, and Color Stability in Purple Carrots (*Daucus carota* L.)

Mehmet Zahid Malaslı^{1,a,*}

¹Necmettin Erbakan University, Ereğli Faculty of Agriculture, Department of Biosystems Engineering, 42310, Konya, Türkiye

*Corresponding author

ARTICLE INFO

Research Article

Received : 07.01.2026

Accepted : 19.02.2026

Keywords:

Purple carrot
Microwave pre-treatment
Drying properties
Energy analysis
Color stability

ABSTRACT

This study investigated the effects of different drying temperatures (50, 60, and 70°C) in the oven and microwave pre-treatment on the drying behavior, effective diffusion values, energy parameters, and color characteristics of purple carrots. The results showed that microwave pre-treatment increased drying rates and accelerated the drying process at all temperatures. Effective diffusion values varied depending on drying temperature and pre-treatment, with higher values obtained at lower temperatures. According to energy analysis results, samples dried at 60°C were found to be more efficient in terms of energy parameters, exhibiting higher specific moisture absorption and lower specific energy consumption values. Color analysis revealed that samples dried with microwave pre-treatment at 60°C retained color characteristics closest to those of the fresh product. Overall, it was concluded that microwave pretreatment improves drying performance and that its application in conjunction with a 60°C drying temperature is a suitable method for drying purple carrots in terms of quality and energy efficiency.

^a mzmalasli@erbakan.edu.tr

<https://orcid.org/0000-0002-5845-1272>



This work is licensed under Creative Commons Attribution 4.0 International License

Introduction

Purple carrot (*Daucus carota* L.) is a root vegetable that contains higher levels of bioactive compounds compared to traditional orange carrots and has attracted increasing attention in functional food research in recent years (Pérez et al., 2023). Anthocyanins, responsible for the characteristic dark color of purple carrots, are water-soluble pigments belonging to the flavonoid class and are known for their strong antioxidant properties. Regular consumption of these compounds is reported to play a potential role in preventing chronic diseases such as cardiovascular diseases, some types of cancer, and metabolic disorders (Arscott & Tanumihardjo, 2010; Stintzing & Carle, 2004). Historically, purple carrots are considered the ancestors of modern orange carrot varieties and were widely cultivated and consumed in many regions until the 16th century. Key reasons for its renewed importance today include its high anthocyanin content, natural coloring potential, and positive effects on health (Arscott & Tanumihardjo, 2010). Purple carrots are also an important vegetable nutritionally as a source of provitamin A due to their content of carotenoids such as β -carotene. Purple carrots differ from other anthocyanin sources in terms of the structural characteristics of the anthocyanins they contain. The presence of cyanoid-based and mostly

acylated anthocyanins ensures that these pigments exhibit higher stability against heat, light, and pH changes. This significantly increases the use of purple carrots as a natural coloring agent in the food industry (Kirca et al., 2006; Montilla et al., 2011). Extensive research is being conducted, particularly on the use of purple carrot-derived pigments as an alternative to synthetic dyes in beverages, fruit products, and fermented foods. However, the amount and bioavailability of anthocyanins and other phenolic compounds found in purple carrots are significantly affected by the processing and preservation methods applied. Processes such as drying, heat treatment, and extraction can increase the release of bioactive compounds through the breakdown of the cell wall; however, high temperatures and long processing times can lead to anthocyanin degradation (Kamiloglu et al., 2015). Therefore, determining appropriate processing conditions in the processing of purple carrots and their derivatives is critical for preserving functional properties. Recent experimental and epidemiological studies have shown that purple carrot consumption increases antioxidant capacity, reduces lipid peroxidation, and has positive effects on inflammation-related biomarkers. These effects are based on the ability of anthocyanins to scavenge free radicals and

activate cellular antioxidant defense mechanisms (Stintzing & Carle, 2004; Arscott & Tanumihardjo, 2010). It has also been reported that phenolic compounds derived from purple carrots may provide indirect benefits on metabolic health by interacting with the gut microbiota. In this context, purple carrots are considered not only a traditional vegetable product but also an important agricultural product that stands out with its functional and nutraceutical properties. Detailed investigation of the behavior of purple carrots under different processing techniques, and their effects on the preservation of bioactive compounds and product quality, is of great importance for both academic studies and the food industry.

The main objective of the present study was to comprehensively evaluate the kinetic, specific moisture absorption rate, specific energy consumption, effective moisture diffusion, activation energy, and color parameters of purple carrot samples dried in oven at temperatures of 50, 60, and 70°C using pre-treatment (microwave).

Materials and Methods

Materials

Fresh purple carrots of (Deep purple cultivar) were sourced from Konya/Ereğli district. The purple carrots were stored in a refrigerator at $4 \pm 0.5^\circ\text{C}$ until the end of the experiments. For moisture determination and drying processes, the purple carrots were thoroughly cleaned by washing them with water to remove any soil. Then, using a sharp knife, they were sliced into circles 3.39 ± 0.17 mm thick.

Methods

Dry Pre-treatment and Drying Processes

To reduce drying time and energy consumption while preserving quality characteristics, purple carrots were pre-treated with microwave blanching before drying. This pre-treatment was carried out in a Vestel MD-GD23 microwave oven at 720 W for one minute. The control group was not pretreated and only dried in an oven. A (Şimşek Labor teknik brand-ST-055 model) oven was used for the drying process at 50, 60 and 70°C.

Moisture Content Determination

The moisture content of fresh purple carrot slices was determined by drying them in an oven at 70°C until weight changes stabilized (Pixton & Warburton, 1973). Equation 1 was used to calculate the initial moisture content of purple carrots.

$$N_{d.b.} = \frac{M_i - M_l}{M_l} \times 100 \quad (1)$$

Here; $N_{d.b.}$: Moisture content based on dry weight, M_i : Wet weight, M_l : Final dry weight. g water/g dry matter.minutes.

Determination of Drying and Moisture Rates

Equation 2 was used to determine the drying rate values of purple carrots (Doymaz et al., 2006).

$$DR = \frac{M_t - M(t+dt)}{dt} \quad (2)$$

Here; M_t : Moisture content (g water, s dry matter, minutes), dt : Time (minutes).

Equation 3 was used to determine the moisture content of the drying processes (Maskan, 2000).

$$MR = \frac{M - M_e}{M_0 - M_e} \quad (3)$$

Here: M denotes the moisture content of the product at any given time (g water g^{-1} dry matter), M_e represents the equilibrium moisture content (g water g^{-1} dry matter), and M_0 corresponds to the initial moisture content of the material (g water g^{-1} dry matter).

Effective Moisture Diffusion

Equation 4 was used to calculate the effective moisture diffusion values of the moisture lost from purple carrot samples (Corzo et al., 2008).

$$\ln MR = \ln \frac{8}{\pi^2} - \frac{\pi^2 \cdot D_{eff} \cdot t}{4L^2} \quad (4)$$

Here, D_{eff} represents the effective diffusion value ($\text{m}^2 \text{s}^{-1}$), L represents half of the product thickness (m), and t represents the time.

Specific Moisture Extraction Rate (SMER)

Equation 5 was used to calculate the specific moisture extraction ratios (SMER) of the drying processes (Surendhar et al., 2019).

$$SMER = \frac{\text{Dried moisture amount (kg)}}{\text{Energy consumed by the dryer (kWh)}} \quad (5)$$

Specific Energy Consumption (SEC)

Equation 6 was used to calculate the specific energy consumption (SEC) values for drying processes (Motevali et al., 2012).

$$SEC = \frac{E_t}{m_w} \quad (6)$$

Here: E_t ; total energy consumed (kWh), m_w ; amount of water removed (kg).

Color values

Color attributes of fresh and dried purple carrot samples were determined using a Minolta CR-300 colorimeter. Based on the measured tristimulus color coordinates (L^* , a^* , b^*), hue angle, chroma, browning index, and total color difference values were calculated. The L^* parameter represents sample lightness on a scale ranging from 0 (black) to 100 (white), while the a^* coordinate describes the red–green axis and the b^* coordinate corresponds to the yellow–blue axis. Positive a^* and b^* values indicate redness and yellowness, respectively, whereas negative values denote greenness and blueness (McGuire, 1992). The hue angle, which reflects the dominant color tone of the samples, was computed from the a^* and b^* values using Equation 7.

$$h^\circ = \tan^{-1} \left(\frac{b^*}{a^*} \right) \quad (7)$$

The chroma value indicates the saturation of a color. Materials with vibrant colors have high values, while materials with dull colors have low values. The chroma value was calculated using Equation 8.

$$C = (a^2 + b^2)^{1/2} \tag{8}$$

Total Color Difference

This parameter quantifies the overall change in color of purple carrot samples after drying relative to their fresh state. The total color difference (ΔE) was calculated using Equation (12), which was derived from the intermediate color coordinate differences obtained from Equations (9), (10), and (11), as described by Çelen et al. (2015).

$$\Delta L = L_{\text{fresh}} - L \tag{9}$$

$$\Delta a = a_{\text{fresh}} - a \tag{10}$$

$$\Delta b = b_{\text{fresh}} - b \tag{11}$$

$$\Delta E = \sqrt{\Delta L^2 + \Delta a^2 + \Delta b^2} \tag{12}$$

Browning Index

This calculates the browning value that occurs in purple carrots after the drying process is complete. The browning index was calculated using Equations 13 and 14 (Plou et al., 1999).

$$X = \frac{a+(1.75 \times L)}{[(5.645 \times L)+(a-(3.012 \times b))]} \tag{13}$$

$$BI = \frac{[100(x-0.31)]}{0.17} \tag{14}$$

Statistical Analysis

All experimental data were subjected to statistical evaluation using SPSS software (version 22.0). Differences among mean values were assessed by Duncan’s multiple range test, with statistical significance defined at $p < 0.05$. Kinetic curves and three-dimensional graphical representations of the drying processes were generated using SigmaPlot software (version 10.0).

Results

Drying Properties

Drying curves for purple carrots are given in Figure 1. Drying temperatures and microwave pre-treatment affected the drying values of purple carrots. The drying rates of the microwave pre-treated carrot samples were determined to be in the range of 0.0145, 0.0165, and 0.0206 g moisture/g dry matter.minute at 50, 60, and 70°C, respectively. Taşova & Dursun (2025) detected a similar results in their shelled pea drying study. The drying rates of the control group carrot samples were calculated to be in the range of 0.0128, 0.0143, and 0.165 g moisture/g dry matter.minute at 50, 60, and 70°C, respectively. Taşova & Dursun (2023), in their drying study, determined the drying rates of Golden delicious L. apple variety samples with different pre-treatments (potassium carbonate, citric acid, and vacuum impregnation) and without pre-treatment (control) in the range of 0.006794-0.06976 g moisture/g dry matter.minute. Aksut et al. (2022) dried purple carrots by pre-treating them with immersion in hot water for 15 minutes and without immersion (control). As a result of their study, they calculated the drying rate of the drying treatments in the range of 0.0034-0.0342 g moisture/g dry matter.minute on average. The obtained results were found to be consistent with studies in the literature.

Effective diffusion values

The effective diffusion values for the drying processes of the purple carrots are given in Table 1. Accordingly, it is observed that drying temperatures and pre-treatments affect the effective diffusion values. According to Table 1, samples dried at 60°C had lower effective diffusion values compared to samples dried at 50°C. This suggests that moisture distribution in samples dried at 50°C occurred more as an aerosol. This phenomenon is estimated to cause an increase in the moisture distribution area and consequently an increase in effective diffusion values. Dursun & Taşova (2025) reported a similar finding in their drying study. Taşova et al. (2024) reported a similar finding in their pumpkin chips study. Garba et al. (2015) determined the effective diffusion values of purple carrots, which they blanched in hot water for 3 and 6 minutes and dried at 40, 50, and 60°C, to be in the range of $1.3\text{-}2.16 \times 10^{-9} \text{ m}^2/\text{s}$.

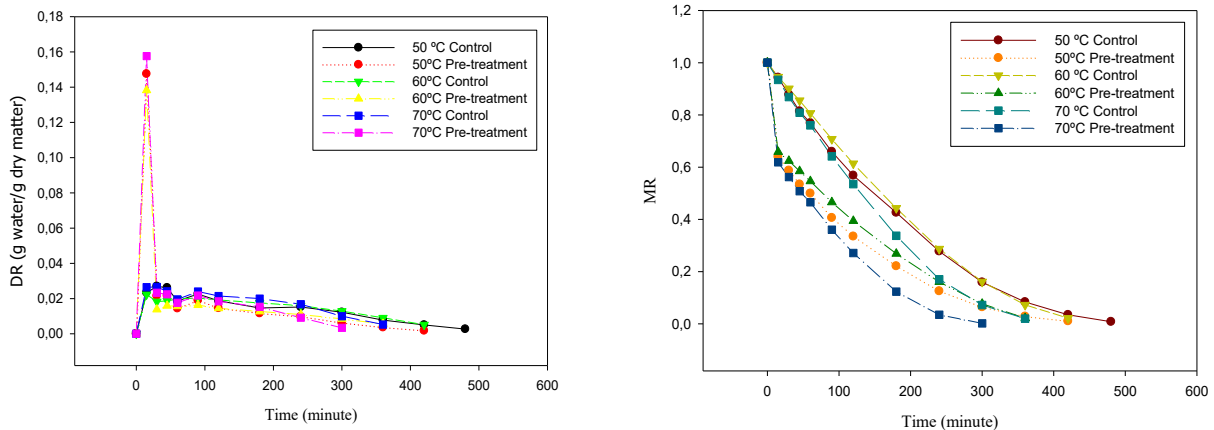


Figure 1. DR and MR kinetics of drying processes

Table 1. Effective diffusion values

Drying technique	Temperature (°C)	Pre-treatment	Effective diffusion (m ² s ⁻¹)	R ²
Oven	50	Control	1.01×10 ⁻⁸	0.932
		Microwave	1.12×10 ⁻⁸	0.976
	60	Control	9.44×10 ⁻⁹	0.931
		Microwave	1.05×10 ⁻⁸	0.944
	70	Control	1.16×10 ⁻⁸	0.942
		Microwave	2.05×10 ⁻⁸	0.894

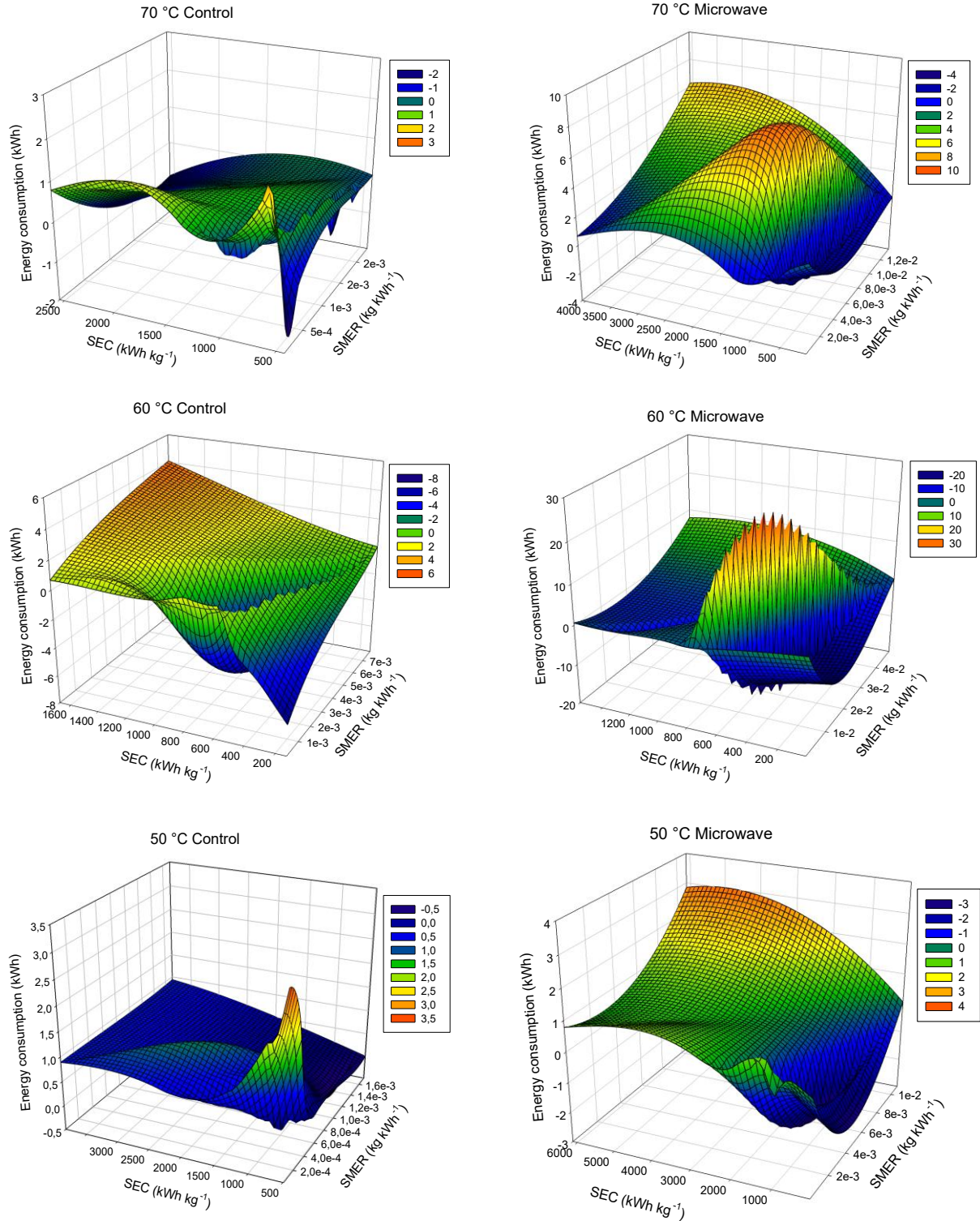


Figure 2. Relationship graph of SMER, SEC, and total energy consumption values.

Table 2. Color values

Temperature	Pre-treatment	L	a	b	C	h°	ΔE	BI
-	Fresh	16.67±1.94 ^c	4.38±0.86 ^e	-1.76±0.58 ^c	4.75±0.85 ^d	-0.38±0.14 ^c	-	-
50°C	Control	21.46±2.54 ^b	6.17±0.98 ^{bc}	-0.55±1.68 ^b	6.39±0.99 ^{bc}	-0.07±0.27 ^b	5.59±2.79 ^b	16.83±4.86 ^c
	Microwave	14.13±0.58 ^d	4.83±1.18 ^{de}	-2.71±0.47 ^d	5.55±1.22 ^{cd}	-0.52±0.07 ^d	3.37±1.59 ^c	4.96±3.28 ^c
60°C	Control	23.26±2.04 ^a	6.89±0.75 ^{ab}	1.40±0.98 ^a	7.09±0.76 ^{ab}	0.20±0.14 ^a	8.04±3.05 ^a	26.44±3.49 ^a
	Microwave	15.26±0.80 ^{cd}	4.57±0.87 ^c	-1.79±0.62 ^c	4.93±0.97 ^d	-0.37±0.09 ^c	2.90±1.27 ^c	9.04±2.78 ^d
70°C	Control	21.20±1.54 ^b	7.51±0.68 ^a	-0.36±0.64 ^b	7.54±0.66 ^a	-0.05±0.09 ^b	5.94±1.90 ^b	22.19±3.01 ^b
	Microwave	14.22±0.73 ^d	5.61±0.81 ^{cd}	-2.68±0.44 ^d	6.23±0.83 ^c	-0.45±0.06 ^{cd}	3.55±1.76 ^c	8.45±2.88 ^d

SMER and SEC values

A three-dimensional representation of the interaction between specific moisture extraction rate (SMER), specific energy consumption (SEC), and total energy consumption for purple carrot slices illustrates in Figure 2. The results demonstrate that both drying temperature and the application of microwave pre-treatment markedly influenced SMER, SEC, and overall energy demand during the drying process. For the control samples, the mean SMER values at 50, 60, and 70°C were calculated as 0.00111, 0.00146, and 0.00124 kg kWh⁻¹, respectively. In comparison, microwave pre-treated purple carrot samples showed higher average SMER values of 0.00125, 0.00167, and 0.00152 kg kWh⁻¹ at the corresponding temperatures. Similarly, the average SEC values of the control samples at 50, 60, and 70°C were determined as 901.51, 685.79, and 804.85 kWh kg⁻¹, whereas the pretreated samples exhibited reduced SEC values of 800.20, 598.81, and 656.92 kWh kg⁻¹, respectively. A comparative evaluation of all drying conditions revealed that samples dried at 60°C achieved a more favorable balance between SMER and SEC than those dried at 70°C. This trend can be attributed to the substantially higher total energy demand associated with the higher drying temperature, which adversely affected overall energy efficiency. Consistent with the observations reported by Dursun et al. (2025) for kiwi powder, the energy performance indicators obtained in the present study exhibited a clear dependence on drying temperature and pre-treatment application. Taşova et al. (2024) expressed a similar result in their studies on pumpkin chips produced by applying pre-treatment.

Color values

The color characteristics of fresh and dried purple carrot samples are presented in Table 2. Statistical analysis indicated that both drying temperature and pre-treatment application had a significant influence on the color parameters of the samples ($p < 0.05$). Notably, purple carrot slices subjected to microwave pre-treatment and subsequently dried at 60°C exhibited color attributes that were statistically comparable to those of the fresh material. In a related study, Aksut et al. (2022) reported L*, a*, b*, chroma, and hue values for fresh and dried purple carrot samples within the ranges of 18.42-30.32, 11.91-14.70, -4.76 to -1.00, 12.87-15.10, and -22.49 to -4.13, respectively, while the total color difference (ΔE) and browning index (BI) varied between 16.40-21.82 and 14.45-25.81. In comparison, the ΔE and BI values obtained in the present study were lower, indicating improved color preservation. Variations observed in the remaining color parameters are primarily attributed to differences in carrot

genotype or cultivar. In their studies where they dried Hatay genotype purple carrots in a hybrid microwave and oven with and without pre-treatment, Taşova et al. (2023) determined the L, a, b, C, hue and ΔE values of fresh and dried samples as 14.64-22.92, 3.86-8.01, -3.19/0.87, 4.20-8.46, -32.74/8.48 and 10.93-18.16, respectively. While the ΔE value in this study was found to be better than that in the literature, the other color parameters were determined to be consistent with the literature.

Conclusion

This research examined the combined influence of convective drying temperature and microwave pre-treatment on the drying behavior, effective moisture diffusivity, energy performance indicators (SMER and SEC), and color attributes of purple carrot slices. The results clearly indicated that both processing temperature and pretreatment strategy exerted a pronounced effect on all evaluated parameters. Analysis of drying kinetics revealed that microwave pre-treated samples consistently exhibited enhanced drying rates across the entire temperature range when compared with untreated counterparts, with the most pronounced acceleration observed at 70°C. These results are in strong agreement with previously reported studies on various agricultural products, including peas, apples, and purple carrots, and further substantiate the role of microwave pre-treatment in facilitating moisture removal during drying.

Evaluation of effective moisture diffusivity demonstrated a significant dependence on both drying temperature and pre-treatment application. The relatively higher diffusivity values obtained in this study, compared with several literature reports, highlight the efficiency of the applied drying conditions and pre-treatment protocol. Regarding energy performance, substantial variations in SMER, SEC, and total energy consumption were observed as a function of drying temperature and microwave pre-treatment. Among all tested conditions, drying at 60°C resulted in the most favorable energy profile, characterized by increased SMER and reduced SEC values. In contrast, operation at 70°C led to elevated total energy consumption, which adversely affected overall energy efficiency, indicating that moderate drying temperatures are more advantageous from an energy perspective.

Colorimetric evaluation showed that both drying temperature and pre-treatment significantly influenced the color parameters of purple carrot samples ($p < 0.05$). Notably, samples subjected to microwave pretreatment and dried at 60°C exhibited color attributes most comparable to those of fresh carrots. The comparatively lower total color

difference (ΔE) and browning index (BI) values, relative to many studies reported in the literature, suggest superior color retention under these conditions. Variations observed in other color parameters are attributed primarily to differences in carrot genotype or cultivar. Overall, the results demonstrate that microwave pretreatment offers substantial benefits by reducing drying duration, enhancing drying rates, lowering energy demand, and improving color preservation. Consequently, the combined use of microwave pre-treatment with a drying temperature of 60°C is proposed as an optimal processing condition for purple carrots in terms of both product quality and energy efficiency. Future investigations should focus on further refinement of this approach by exploring alternative drying techniques, varying pre-treatment intensities, and assessing additional quality indicators such as bioactive compound retention and antioxidant capacity.

Declarations

Ethical Approval Certificate

None

Author contribution Statement

Mehmet Zahid Malaslı: Data collection, conceptualization, methodology, analysis, investigation, writing and editing.

Fund statement

This study was not funded by any institution.

Conflict of interest

The author in the study has no conflict of interest.

References

- Aksut, B., Dursun, S. K. & Tasova, M. (2022). Sıcak Suya Daldırma İşleminin Kalite Özellikleri ve Kuruma Kinetiği Parametrelerine Etkisi: Mor Havuç Örneği, *Ereğli Tarım Bilimleri Dergisi*, 2(1), 32-40. <https://doi.org/10.54498/etbd.2022.9>
- Arscott, S. A., & Tanumihardjo, S. A. (2010). Carrots of many colors provide basic nutrition and bioavailable phytochemicals acting as a functional food. *Comprehensive Reviews in Food Science and Food Safety*, 9(2), 223–239. <https://doi.org/10.1111/j.1541-4337.2009.00103.x>.
- Corzo, O., Bracho, N., Pereira, A., Vasquez, A. 2008. Weibull distribution for modeling air drying of coroba slices. *LWT- Food Science and Technology*, 41(10), 2023-2028. <https://doi.org/10.1016/j.lwt.2008.01.002>
- Çelen, İ.H., Çelen, S., Moralar, A., Buluş, H. N. ve Önler, E., 2015. Mikrodalga bantlı kurutucuda patatesin kurutulabilirliğinin deneysel olarak incelenmesi. *Electronic Journal of Vocational Colleges- Special Issue: The Latest Trends in Engineering*, 5(4): 242- 287. <https://doi.org/10.17339/ejovoc.63399>
- Doymaz, İ., Tugrul N., Pala, M. (2006). Drying characteristics of dill and parsley leaves. *Journal of Food Engineering*, 77, 559-565. <https://doi.org/10.1016/j.jfoodeng.2005.06.070>
- Dursun, S. K., & Taşova, M. (2025). Dip döküntü Göksulu Armutlardan üretilen meyve cipsinin fiziko-kimyasal ve enerji tüketim özelliklerine değişken mikrodalga-konvektif yöntemlerin etkisi. *Pamukkale University Journal of Engineering Sciences*, 31(2), 331-337. <https://doi.org/10.5505/pajes.2024.92929>
- Dursun, S. K., Taşova, M., & Öcalan, O. N. (2025). Effects of kiwi powder produced by hybrid microwave drying method on drying kinetics, energy parameter, thermal, physicochemical and bioactive properties. *International Communications in Heat and Mass Transfer*, 169, 109664. <https://doi.org/10.1016/j.icheatmasstransfer.2025.109664>
- Garba, U., Kaur, S., Gurumayum, S., & Rasane, P. (2015). Effect of hot water blanching time and drying temperature on the thin layer drying kinetics of and anthocyanin degradation in black carrot (*Daucus carota* L.) shreds. *Food Technology and Biotechnology*, 53(3), 324-330. <https://doi.org/10.17113/ftb.53.03.15.3830>
- Kamiloglu, S., Paslı, A. A., Ozcelik, B., Van Camp, J., & Capanoglu, E. (2015). Influence of different processing and storage conditions on in vitro bioaccessibility of polyphenols in black carrot jams and marmalades. *Food chemistry*, 186, 74-82. <https://doi.org/10.1016/j.foodchem.2014.12.046>
- Kirca, A., Ozkan, M., & Cemeroglu, B. (2006). Stability of black carrot anthocyanins in various fruit juices and nectars. *Food Chemistry*, 97(4), 598–605. <https://doi.org/10.1016/j.foodchem.2005.05.036>
- Maskan, M. (2000). Microwave/air and microwave finish drying of banana. *Journal of Food Engineering*, 44, 71-78. [https://doi.org/10.1016/S0260-8774\(99\)00167-3](https://doi.org/10.1016/S0260-8774(99)00167-3)
- McGuire, R.G. 1992. Reporting of objective color measurements. *HortScience*, 27: 1254-1255.
- Montilla, E. C., Arzaba, M. R., Hillebrand, S., & Winterhalter, P. (2011). Anthocyanin composition of black carrot (*Daucus carota* ssp. *sativus*) cultivars. *Food Chemistry*, 127(1), 234–240. <https://doi.org/10.1021/jf104724k>
- Motevali, A., Abbaszadeh, A., Minaei, S., Khoshtaghaza, M.H., Ghobadian, B. 2012. Effective moisture diffusivity, activation energy and energy consumption in thin-layer drying of jujube (*Zizyphus jujube* Mill). *Journal of Agricultural Science and Technology*, 14(3), 523-532.
- Pérez, M. B., Carvajal, S., Beretta, V., Bannoud, F., Fangio, M. F., Berli, F., ... & Cavagnaro, P. F. (2023). Characterization of purple carrot germplasm for antioxidant capacity and root concentration of anthocyanins, phenolics, and carotenoids. *Plants*, 12(9), 1796. <https://doi.org/10.3390/plants12091796>
- Pixton SW, Warburton S. 1973. Determination of moisture content and equilibrium relative humidity of dried fruit-Sultanas[®]. *Journal of Stored Products Research*, 8(4), 263-270.
- Plou E, Lopez-Malo A, Barbosa-Canovas GV, Welti-Chanes J, Swanson BG. 1999. Polyphenoloxidase activity and color of blanched and high hydrostatic pressure treated banana puree. *Journal of Food Science*, 64: 42-45. <https://doi.org/10.1111/j.1365-2621.1999.tb09857.x>
- Stintzing, F. C., & Carle, R. (2004). Functional properties of anthocyanins and betalains in plants, food, and human nutrition. *Trends in Food Science & Technology*, 15(1), 19–38. <https://doi.org/10.1016/j.tifs.2003.07.004>
- Surendhar, A., Sivasubramanian, V., Vidhyeswari, D., Deepanraj, B. 2019. Energy and exergy analysis, drying kinetics, modeling and quality parameters of microwave-dried turmeric slices. *Journal of Thermal Analysis and Calorimetry*, 136,185–197. <https://doi.org/10.1007/s10973-018-7791-9>
- Taşova, M., & Dursun, S. K. (2025). Assessment of Experimental Energy Consumption and Drying Kinetics Analyses of Processing Waste Pea (*Pisum sativum*) by Convective Drying. *Turkish Journal of Agriculture-Food Science and Technology*, 13(8), 2187-2193. <https://doi.org/10.24925/turjaf.v13i8.2187-2193.7817>
- Taşova, M., Dursun, S. K. (2023). *Golden delicious* L. çeşidi elmanın kuruma özelliklerine ön işlemlerin etkisi. *Tekirdağ Ziraat Fakültesi Dergisi*, 20(2): 374-386. <https://doi.org/10.33462/jotaf.1117872>

- Taşova, M., Dursun, S. K., Öcalan, O. N., Çezik, F. (2024). Effects of Osmotic Processes on the Bio-Active and Physico-Chemical Properties of Pumpkin Chips Produced by Convective Drying. *Iran. J. Chem. Chem. Eng. (IJCCE) Research Article Vol, 43(4)*.
- Taşova, M., Malaslı, M. Z., & Dursun, S. K. (2023). The effect of drying methods and pretreatment on physico-chemical, energy consumption and thermodynamic analysis of “Hatay” genotype purple carrot slices. *Journal of Thermal Analysis and Calorimetry, 148(22), 12711-12723*. <https://doi.org/10.1007/s10973-023-12576-5>