International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2025; 9(1): 716-719
www.biochemjournal.com
Received: 02-11-2024
Accepted: 06-12-2024

Shweta Nilvarn
B.Tech. Student, College of Agricultural Engineering &Technology, VNMKV, Parbhani, Maharashtra, India

Pramodini More
Assistant Professor, College of Agricultural Engineering &Technology, VNMKV, Parbhani, Maharashtra, India

Veenika Singh
SMS Home Science, ICAR-IIR, Lucknow, Uttar Pradesh, India

Neha Jadhav
B.Tech. Student, College of Agricultural Engineering &Technology, VNMKV, Parbhani, Maharashtra, India

Corresponding Author:
Shweta Nilvarn
B.Tech. Student, College of Agricultural Engineering &Technology, VNMKV, Parbhani, Maharashtra, India

Comparative studies on osmo-convectively dehydrated carrot shreds prepared from pink and orange carrot

Shweta Nilvarn, Pramodini More, Veenika Singh and Neha Jadhav

DOI: https://doi.org/10.33545/26174693.2025.v9.i1i.3614

Abstract
Carrots (*Daucus carota* L.) are a highly nutritious root vegetable widely consumed for its health benefits, vibrant color, and versatility in culinary applications. Being rich in carotenoids, vitamin A, dietary fibre, and antioxidants, carrots contribute significantly to a balanced diet. However, fresh carrots are susceptible to spoilage due to high moisture content. In order to extend shelf life and provide ease of convenience, experiment was planned to explore combo-processing techniques, specifically osmo-convective dehydration, on pink and orange carrot shreds. The carrot shreds were subjected to pre-treatment of steam blanching before osmotic and convective dehydration. Quality attributes such as solid gain, water loss, texture, colour retention, and sensory evaluation of osmo-convectively dried shreds of both pink and orange carrot were determined. The mass transfer parameter (water loss and solid gain) was higher in the pink carrot (27.49, 38.93) than in the orange carrot (23.80, 36.75). The colour value a* was more for pink carrot shreds while orange carrot exhibited higher colour value b*. Osmo-convectively dehydrated shreds of orange carrots showed soft texture than that of pink carrot. The overall acceptability of osmo-convectively dehydrated carrot shreds prepared from pink carrot without xylem was similar to that of orange carrot.

Keywords: Carrot shreds, blanching, osmotic dehydration, mass transfer, sensory acceptance

Introduction
Carrots (*Daucus carota* L.) are highly nutritious root vegetable and popular for their vibrant colour, sweet flavour, and numerous health benefits. Packed with carotenoids, vitamins, dietary fibre, and antioxidants, carrots play a vital role in a balanced diet (Ikram A. *et al*., 2024) [5]. A 100 g serving of fresh raw carrots is a rich source of essential nutrients, including with 42 kcal of energy, 1.1 g protein, 1100 IU vitamin A, 8 mg ascorbic acid, 0.06 mg thiamine, calcium 37 mg, phosphorus 36 mg and 0.7 mg iron (Thamburaj and Singh, 2005) [12].

Dark orange carrots boast exceptionally high carotenoid levels at 26.55 mg/100 gm, while medium orange variety ranges from 5.99 to 12.52 mg/100 gm, and the yellow type contains only 0.47-0.56 mg/100 gm (Nicolle *et al*., 2004) [9]. Pink carrots offer a unique flavour profile and a distinctive set of nutrients. However, high moisture content of carrot makes them susceptible to spoilage, limiting their shelf life and convenience. (Venkatesan, U., *et al*, 2024) [14]. Innovative combo-processing techniques via blanching, freeze-thaw pre-treatment followed by osmo-convective dehydration was developed by transforming fresh carrots into osmo-convectively dehydrated carrot slices to extend its shelf life and preserve their nutritional value (More, P. G. 2020) [6].

Blanching is a treatment usually performed before food processes such as drying, freezing, frying and canning. Blanching before dehydration enhances the retention of β-carotene in the stored dehydrated product, likely due to enzyme inactivation (Negi P. S *et al*., 2000) [8]. However, seasonal availability and limited liking for fresh carrot especially by children, Ready to Eat carrot shreds from orange carrots were prepared using combo-process technology and also an effect of different pre-treatments on quality of final dehydrated shreds were studied (Vaidya Pallavi, *et al* 2023) [13]. In order to assess the applicability of developed process technology for RTE carrot shreds prepared from orange carrot to pink carrot, the present investigation of comparative quality evaluation of physical parameters of orange and pink carrots was carried out and mass transport parameters and other quality attributes of osmo-convectively dehydrated carrot shreds were also evaluated.

Materials and Methodology

Twenty fresh carrots of each pink and orange colour were selected at random from representative mass to measure its length and diameter. Length and diameter (major, intermediate and minor) of each carrot was measured using Vernier calliper. The weight of each carrot was determined using an electronic weighing balance. The weight of the peeled carrot, carrot's peel, and shreds were also measured. Pink and orange carrot shreds were peeled and carrots shreds were prepared using a vegetable grater.

The moisture content of fresh carrots was determined according to the hot air oven method described by AOAC (2005) [3]. Shreds recovery was determined in terms of weight of carrot shreds expressed as a percentage based on the weight of freshly peeled carrots (Selvakumar and Tiwari *et al*., 2018) [11].

$$\text{Shreds recovery (\%)} = \frac{\text{Weight of carrot shreds}}{\text{weight of peeled carrot}} \times 100$$

Sample preparation

Fresh, fully grown, firm pink and orange coloured carrots were purchased from the local market and peeled with hand peeler. Pink carrots were shredded with and without inside core part as per treatments. Carrots shreds thus prepared from orange as well pink carrot were steam blanched for 2 minutes (More and Khodke 2022) [7]. Blanched carrot shreds were dipped in a sugar solution of 50°Brix concentration using a shred to solution ratio of 1:4 for four hours. The temperature of the syrup was maintained at 50 °C during the osmotic dehydration process (Vaidya Pallavi, *et al*, 2023) [13]. After four hours, the carrot shreds were removed from the sugar solution, and excess syrup was wiped out with the help of tissue paper. The carrot shreds were weighed before and after osmosis for the determination of mass transport parameters. Osmotically dehydrated shreds were dried at 60 °C in a tray dryer with up to 5±1% (w b.) moisture content.

Evaluation of quality parameters

Mass transport parameters of osmo-dehydrated carrot shreds were determined in terms of water loss, solid gain and weight reduction (El-Aouar *et al*, 2006) [2]. Water loss was determined as the net loss of water from a sample per hundred grams of fresh carrot shreds based on an initial mass. Sugar or solid gain was calculated as net solute gain by a hundred grams of carrot shreds based on the initial weight of carrot shreds. Weight reduction is the difference between water loss and solid gain.

$$\text{Water loss (\%)} = \frac{wiXi - wfXf}{wi} \times 100$$

$$\text{Solid gain (\%)} = \frac{\{[\![wf(1-Xf)/100]\!] - [\![wi(1-Xi)/100]\!] \times 100\}}{wi}$$

Where,

w_i- = Initial weights (time t) of samples (g),

w_f = Final weights (time t) of samples (g)

Xi = Initial moisture content (time t) of samples

Xf = Final moisture content (time t) of samples, respectively.

The hardness (N) of the carrot shreds was taken as the force in compression that corresponded to the breakage of samples using a Texture Analyzer (Model: TA-XT plus, Stable Micro System, UK) (Bachir *et al*., 2011) [4]. The color of the fresh and osmo-convectively dried carrot shreds was measured in terms of L*, a*, and b* values using a Hunter lab Colour Analyzer.

Sensory quality parameters of osmo-dehydrated carrot shreds prepared from pink and orange carrots were evaluated with the help of a panel consisting of 10 semi-trained members using a 9-point hedonic scale by standard method (ISI) (1971a-1971b). The various quality aspects viz; color, appearance, texture, taste, favor, and overall acceptability were considered for evaluation.

Results and Discussion

Physical properties of orange and pink fresh carrots

Orange and pink carrots were analyzed to determine their physical properties and average values are represented in Table 1. The results indicated that average length of orange carrot was 16.59 cm whereas 22.83 cm length was found for pink carrot which was longer than orange carrots. Higher values for major, minor and intermediate diameter were noted for orange carrots than pink carrots. Shred recovery of pink carrot was recorded as 83.27% where as for orange carrot it was found as 89.75%. Higher shred recovery of orange carrot might be attributed due to its comparatively smooth peel and less central core portion while pink carrots have uneven and fibrous outer surface.

Table 1: Physical properties of orange and pink fresh carrot

Parameters		Orange Carrot	Pink Carrot
Length, (cm)		16.59	22.83
Major Diameter, (cm)		4.60	3.96
Intermediate Diameter, (cm)		3.60	2.96
Minor Diameter, (cm)		2.05	1.50
Weight of whole carrot, (g)		115.82	105.32
Weight of peeled carrot, (g)		102	92.15
Weight of peeled and non-edible top portion, (g)		24.22	32.25
Shreds recovery (%)		89.75	83.27
Moisture content (w.b.), %		83.25	85.76
Color value	L*	41.43	23.20
	a*	27.19	31.71
	b*	40.76	34.50

It is also revealed from Table 1, that orange and pink carrot exhibited 83.25 and
85.76% moisture content respectively. Colour value a* 31.71 was recorded for pink carrot while it was 27.19 for orange carrot. However b* value was found higher for orange carrot than pink.

Quality parameters of osmo-convectively dehydrated carrot shreds

Osmo-convectively dehydrated carrot shreds were prepared from orange and pink carrots as per treatment under experimentation. The samples were analyzed to assess the impact of orange and pink carrots on mass transfer, texture, colour and sensory parameters during the osmo-convective dehydration process and data is depicted in Fig 1 and Fig. 2.

Mass transfer parameters

Water loss during the osmotic dehydration varied from 23.80 to 28.53% where as solid gain was observed from 36.75 to 39.49%. Overall higher values of solid gain were recorded than the water loss for all the treatments which resulted in negative weight reductions during osmosis for both pink and orange carrots. These higher sugar gain than

water loss is due the blanching pretreatment to carrot shreds before osmotic dehydration. The blanching pre-treatment significantly disrupts the resistance to mass transfer through the skin layer and significantly increases the solids uptake without increasing much moisture removal (Rennie *et al.*, 2013) [10]. This in turns resulted in higher solids uptake rather than enhanced water removal. The treatment T_3 i.e. osmo-convectively dehydrated pink carrot shreds prepared from pink carrot without core (xylem) showed highest water loss and solid gain among the treatment while lowest solid gain and water loss was observed for T_1 i.e. osmo-convectively dehydrated carrot shreds prepared from orange carrot. Highest solid gain and water loss for pink carrot without xylem might be due higher moisture content in it. The moisture content results in a higher driving force for mass transport between product and solution

Colour and texture

Osmo-convectively dehydrated carrot shreds prepared from orange carrots exhibited less hardness as compared to both samples T_2 and T_3. Lower sugar gain and uniform structure of orange carrot might have resulted in lower value of hardness than pink carrot. Instead pink carrot with core part showed highest hardness among the treatments. The pink osmo-convectively dehydrated carrot shreds samples of T_3 treatment i.e. without core part showed less hardness compared to that of sample with core part (T_2). However, very less difference in hardness was observed for T_2 and T_3 treatments.

From the Fig. 2, it is revealed that colour value L* is lowest in the sample T_3 prepared from pink carrot, while highest value was noted for the sample (T_2) because of its core parts contributing lightness in colour. Colour value a* indicating the darkness was observed less in for osmo-dehydrated carrot shreds prepared from orange carrots. On the other hand T_1 treatment exhibited higher b* value than pink carrot due to brightness of orange carrot.

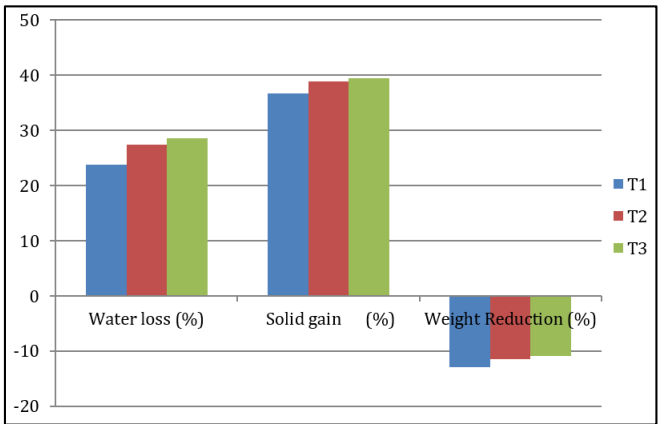

Fig 1: Mass transfer parameter of osmo- dehydrated carrot shreds prepared from orange and pink carrots

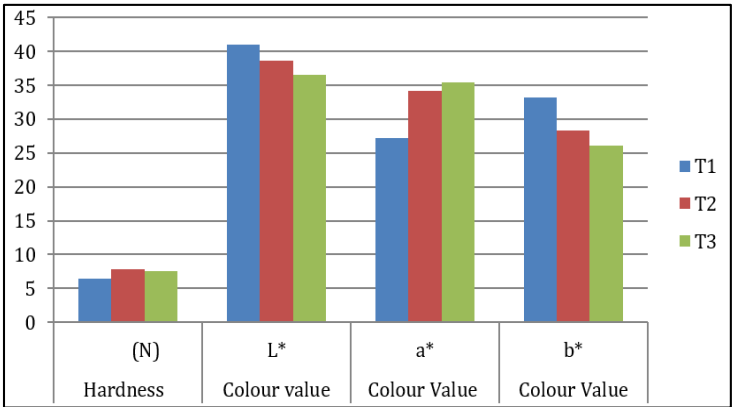

Fig 2: Colour and texture of osmo-convectively dehydrated carrot shreds prepared from orange and pink carrots

Where

T_1- Osmo-convectively dehydrated shreds of orange carrot

T_2- Osmo-convectively dehydrated shreds of pink carrot with the core part.

T_3- Osmo-convectively dehydrated shreds of pink carrot without core parts.

Sensory evaluation

The sensory evaluation of different samples prepared as per experimental trials were carried out and data is represented in Fig. 2. It is cleared from the Fig. 2, that appearance of sample of treatment T_1 and T_3 were highly rated as compared to samples of T_2 treatments. The sensory score for colour and texture of osmo-dehydrated carrot shreds prepared from pink carrot with core were found less than other two samples due to lightness of core present in it. The parameter taste of carrot shreds of orange and pink carrot without the central core were rated positively and obtained almost equal score. While taste of sample T_2 scored less value due to bitterness of core affecting the overall taste of shreds after osmo-dehydration. From the score obtained for overall acceptability, it is revealed that judges preferred osmo-convectively dehydrated carrot shreds prepared from orange (T_1) and the pink carrot without core part (T_3) than osmo-convectively dehydrated carrot shreds prepared from pink carrot with core/xylem.

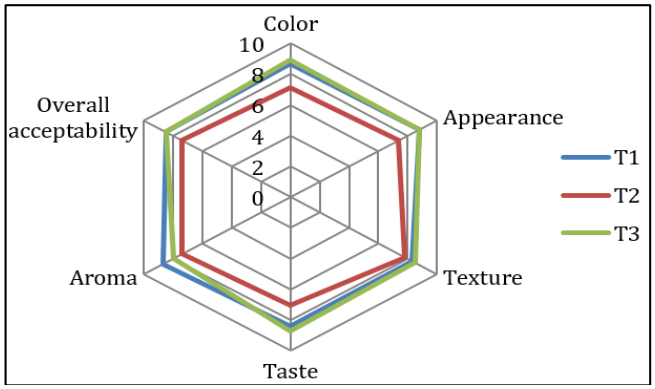

Fig 3: Sensory evaluation of osmo-convectively dehydrated carrot shreds prepared from orange and pink carrots

Conclusion

This study investigated the impact of different coloured carrot (orange vs. pink) on the quality of osmo-convectively dehydrated carrot shreds. Osmo-convectively dehydrated carrot shreds prepared from orange carrot exhibited less values of mass transfer parameters and hardness than osmo-convectively dehydrated carrot shreds of pink carrot. No significant difference was observed in the overall acceptability of samples from pink carrot without xylem and orange carrot shreds.

References

1. Ahmad T, *et al*. Phytochemicals in *Daucus carota* and their health benefits—review article. Foods. 2019;8(9):424. doi: 10.3390/foods8090424.
2. El-Aouar Â, Azoubel PM, Barbosa JL, Murr FEX. Influence of the osmotic agent on the osmotic dehydration of papaya (*Carica papaya* L.). J Food Eng. 2006;77(3):507-514. doi: 10.1016/j.jfoodeng.2005.04.016.
3. AOAC. Official methods of analysis. 18th ed. AOAC International; 2005.
4. Bachir B, Besbes S, Attia H, Blecker C. Osmotic dehydration of pomegranate seeds (*Punica granatum* L.): Effect of freezing pre-treatment. J Food Process Eng. 2012;35(3):335-354.
5. Ikram A, Rasheed A, Ahmad Khan A, Khan R, Ahmad M, Bashir R, Hassan Mohamed M. Exploring the health benefits and utility of carrots and carrot pomace: a systematic review. Int J Food Prop. 2024;27(1):180-193.
6. More PG. Development of combo-process technology for RTE carrot slices. Doctoral dissertation, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, MS, India. 2021.
7. More PG, Khodke SU. Effect of blanching time on quality parameters of blanched carrot slices. The Pharma Innovation J. 2023;12(1):1699-1702.
8. Negi PS, Kumar Roy S. The effect of blanching on quality attributes of dehydrated carrots during long-term storage. Eur Food Res Technol. 2001;212(6):445-448.
9. Nicolle C, Simon G, Rock E, Amouroux P, Rémésy C. Genetic variability influences carotenoid, vitamin, phenolic, and mineral content in white, yellow, purple, orange, and dark-orange carrot cultivars. J Am Soc Hortic Sci. 2004;129(4):523-529. doi: 10.21273/jashs.129.4.0523.
10. Rennie TJ, Mercer DG. Effect of blanching on convective drying and osmotic dehydration of cranberries. Trans Am Soc Agric Biol Eng. 2013;56(5):1863-1870.
11. Selvakumar R, Tiwari RB. Osmotic dehydration of temperate carrot (*Daucus carota* L.). Indian Farmer. 2006;1236:1253.
12. Thamburaj S, Singh N. Textbook of Vegetables, Tuber Crops and Spices. New Delhi: Indian Council of Agriculture Research; 2005. p. 151.
13. Vaidya P, More P, Handibag A. Effect of various pretreatments on quality of osmo-convectively dehydrated carrot shreds. Int J Adv Biochem Res. 2024;SP-8(1):895-898.
14. Venkatesan U, Muniyan R. Review on the extension of shelf life for fruits and vegetables using natural preservatives. Food Sci Biotechnol. 2024:1-20.