International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(6): 1357-1360

Received: 25-09-2019
Accepted: 27-10-2019

PG More
Assistant Professor,
Department of Agricultural
Process Engineering, VNMKV,
Parbhani, Maharashtra, India

SU Khodke
Head, Department of
Agricultural Process
Engineering, VNMKV,
Parbhani, Maharashtra, India

Corresponding Author:
PG More
Assistant Professor,
Department of Agricultural
Process Engineering, VNMKV,
Parbhani, Maharashtra, India

Effect of slice thickness on overall acceptability of Osmo-convectively dried carrot slices

PG More and SU Khodke

Abstract
Carrot is grown all over the world for its fleshly delicious, attractive edible roots and have important place in human diet. Carrot has remarkable nutritional and health benefits and hence to make it convenient and easily available in offseason, osmotic dehydration followed by mechanical drying is one of the processing techniques to make the self stable and ready to eat products. In the present work, different slice thickness was evaluated for its effect on osmotic dehydration characteristics, hardness, total colour difference and overall acceptability. Sugar solution concentration of 50 ºBrix and 50 ºC temperature was used for osmosis process for four hour immersion time. Mass transfer parameter such as weight reduction, solid gain, water loss and total colour difference during osmotic dehydration increased with decrease in slice thickness, whereas hardness has liner effect on slice thickness. Carrot slice of 3mm thickness scored higher score in all organoleptic quality parameter.

Keywords: Osmotic dehydration, slice thickness, solid gain, hardness, total colour difference

Introduction
Carrot (*Daucus carota* L.) is a healthy and nutritious vegetable that has worldwide distribution and is widely known for various medicinal properties. A rapid rise in the popularity of orange carrots was observed with the recognition of its high pro-vitamin A content. Carotenoids and anthocyanins are the major antioxidant pigments found in carrots. Among 39 fruits and vegetables carrots have been ranked 10th in nutritional value. Carrot is a good source of dietary fiber and of the trace mineral molybdenum, rarely found in many vegetables (Silva Dias, J.C. (2014) [1]. Carrots like other vegetables are highly seasonal and abundantly available at particular time of the year. For extending the availability of carrot in the form of its product, several preservation processes can be used such as blanching, pickling, freezing, drying and dehydration. In conventional drying process, food material is subjected to high temperature-time combinations which sometimes adversely affect the flavor, colour and textural properties of final product. The osmotic dehydration before the conventional drying is good alternative to enhance the mass transfer rate or to shorten the duration of drying time. Hence, the use of an osmotic treatment before conventional drying has received considerable attention recently as a means of enhancing the texture, taste, nutrient retention and color stability of several products. Osmotic treatment consists in partially removing water from the product by immersing it in aqueous solutions of sugar, salt or spices (Ruiz-Cabrera, *et. al.*, 2008) [2]. The concentration, temperature, immersion time, solution to sample ratio of osmotic solution and agitation during osmosis process are important factors which affects the quality of final products (Singh and Gupta, 2007) [3]. Thickness of the slices is also one of the major parameter which affects the overall acceptability of the product. Hence, the present works was conducted to assess the effect of thickness of carrot slice on overall acceptability of osmo-convectively dried carrot slices.

Materials and Methods
The research was carried out at the department of Agricultural Process Engineering, College of Agricultural Engineering and Technology, VNMKV, Parbhani.

Preparation of sample
Fresh and healthy carrots without any physical damage were selected for experiment. Carrots were peeled to remove undesirable hair and skin. Peeled carrots were thoroughly washed with water and sliced into 2, 3 and 4 mm thick slices with stainless steel slicer after removing

un-edible top and bottom portion. Osmotic dehydration was conducted at 50 °C syrup temperature for steam blanched and pre-frozen carrot slices of different thickness as per treatment. Sugar syrup concentration of 50 °Brix and sample to sugar syrup ratio of 1:4 was maintained during osmosis process. After four hour, osmosed slices were removed from sugar solution and excess syrup was wiped out with tissue paper. Partially dehydrated samples were further subjected to mechanical drying at 60 °C temperature up to desired final moisture content. Analysis of variance (ANOVA) was conducted to determine the effect of slice thickness on osmotic dehydration characteristic, hardness, colour difference and sensory qualities of osmotically dehydrated carrot slices.

Osmotic dehydration characteristics

Osmotic dehydration characteristics such as water loss (WL), weight reduction (WR), and solid gain (SG) were determined by the following expressions (Nazni and Thara, 2011; Singh, *et al.*, 2007) [4, 3].

WL (%) = Water loss/100 g fresh fruit

$= [(W_0 - Wt) + (St - S_0)] \times 100 / W_0$

WR (%) = Weight Reduction / 100 g fresh fruit

= [Initial mass- Mass at time (T)] / Initial mass

SG (%) = Solute gain/100 g fresh fruit

$= (St - S_0) \times 100 / Wo$

Where,

W_0 -- Initial wt of fruit (g),

Wt -- Weight of fruit after osmotic dehydration for any time t (g),

S_0 -- Initial weight of solids (dry matter) in the fruit (g), and

St -- Weight of solids (dry matter) of fruit after osmotic dehydration for time t (g).

Hardness and Colour Difference

The textural characteristics of osmo-dehydrated carrot slices was measured in terms of hardness using a Stable Micro System, TA-XT2 texture analyzer (Texture Technologies Corp., UK) (Nath, *et. al.*, 2013) [5]. The color of the fresh carrot slices and osmo-convectively dried carrot slices was measured in terms of L*, a* and b* values using a Hunter lab Color Analyzer- Labscan-2 (Hunter Associates Laboratory, Inc. Virginia, USA). Total colour difference (ΔE) was calculated according to the following formula (Ruiz-Cabrera, *et. al.*, 2008) [2]. Where *Lo**, *ao**, and *bo** denote the color parameters before the drying process; and *L**, *a**, and *b** correspond to values of final osmo-convectively dried slices.

$$\Delta E = [(Lo^* - L^*)^2 + (ao^* - a^*)^2 + (bo^* - b^*)^2]^{1/2}$$

Organoleptic quality evaluation

Osmo-dehydrated carrot slices were subjected to sensory evaluation for different sensory attributes like colour and appearance, texture, flavor and overall acceptability. Sensory evaluation was carried out by standard method (ISI) (1971a-1971b) with the help of a panel consisting of 10 semi-trained judges. The samples were presented randomly before judges. The 9 point hedonic scale was used for evaluation for assigning the numerical values for different quality attributes.

Results and discussion

Significant differences were recorded for percent water loss (WL), weight reduction (WR), solid gain (SG), hardness, colour difference and organoleptic quality parameters in osmosed carrot slices as influenced by slice thickness at 1% level significance.

Water loss, weight reduction and solid gain

Figure 1 shows the effect of slice thickness on water loss, weight reduction and solid gain for osmo-convectively dried carrot slices when dipped into 50 °Brix sugar solution at 50 °C solution temperature for four hour immersion time. The water loss, weight reduction and solid gain were higher for 2 mm thick slice compared to those with 3 mm and 4 mm of thickness. It is clear from the data that weight reduction, water loss and solids gain increased with decrease in slice thickness. Rastogi and Raghavarao (1997) [6] reported similar results for osmo-dehydration of carrot. The increase of water loss and solids gain with decrease in thickness may be due to the width ratio and the increase on surface area in contact with the osmotic solution (Kolawole *et al*, 2007) [7]. If the solid is bigger in size, it will dehydrate more slowly because the length of the diffusion path is greater. Smaller pieces on the other hand dehydrate more rapidly (Rastogi, *et. al.*, 2002) [8].

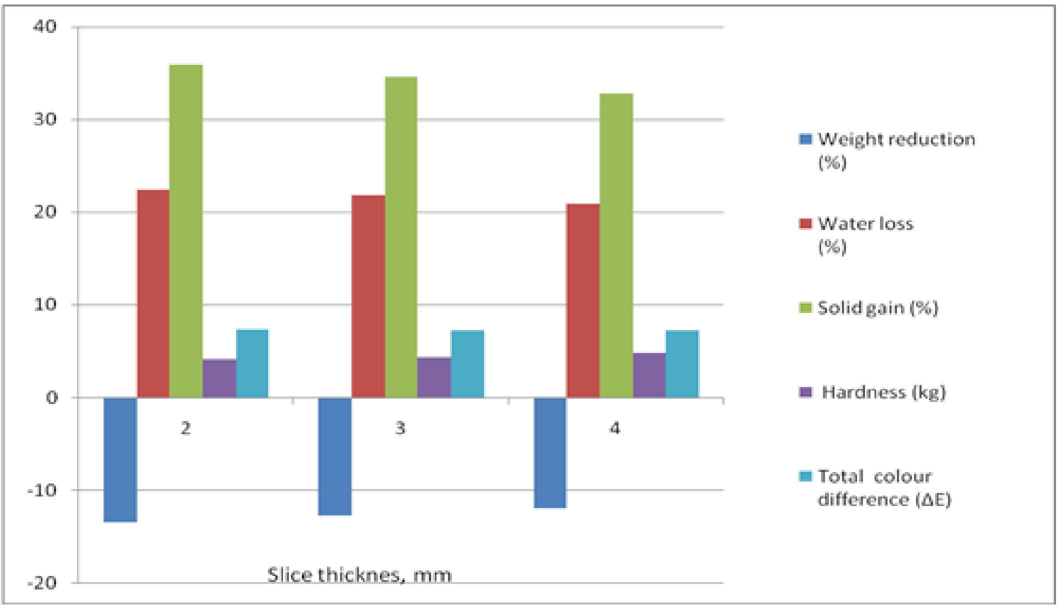

Fig 1: Effect of thickness of slice on osmosis charactristcs, hardness and total colour difference of osmo-convectively dried carrot slices

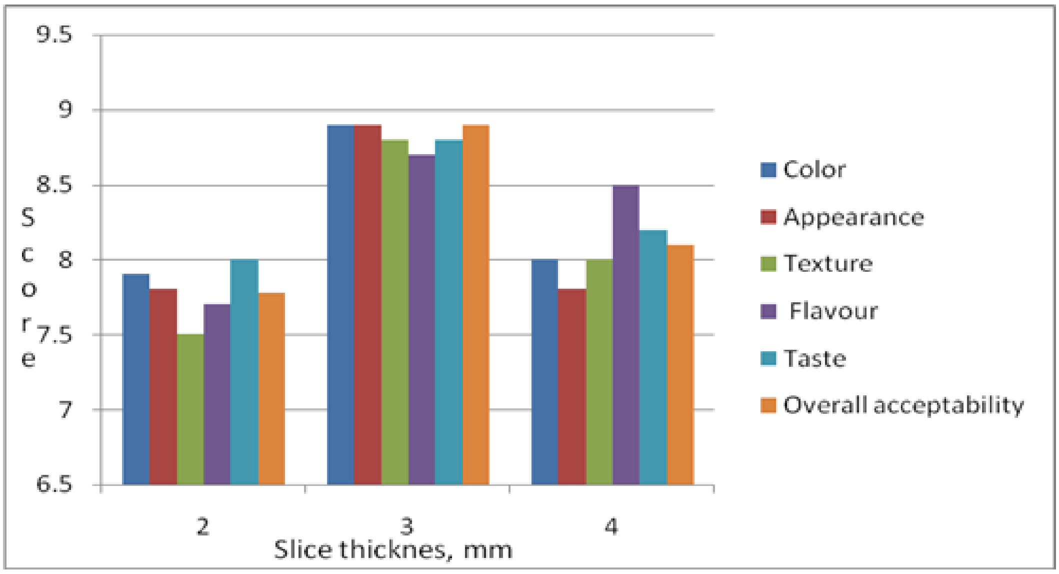

Fig 2: Effect of thickness of slice on organoleptic quality parameters of osmo-convectively dried carrot slices

Table 1: ANOVA for the effect slice thickness on response variables.

Effect	Weight Reduction (%)	Water Loss (%)	Sugar Gain (%)	Hardness (kg)	Total colour difference	Colour	Appearance	Texture	Flavour	Taste	Overall Acceptability
C.D.*	0.126	0.030	0.037	0.035	1.826	0.357.	0.353	0.407	0.421.	0.353	0.204
SE(m)	0.036	0.008	0.011	0.010	0.517	0.058	0.100	0.115	0.058	0.100	0.058
C.V.	0.144	0.043	0.054	0.239	0.020	1.127	2.022	2.371	1.150	2.030	1.141
S.S.	3.615	3.408	14.037	65.90	0.019	1.367	1.460	0.980	0.965	1.280	0.140
M.S.	1.808	1.704	7.018	32.95	0.009	0.635	0.730	0.490	0.465	0.640	0.070

*- 1% level of significance

Effect of slice thickness on hardness and colour difference

The data regarding the hardness revealed that hardness significantly affected by the slice thickness. Hardness value varied from 4.19 to 4.81kg for 2 to 4mm thickness. It is indicated that hardness increases with increase in slice thickness. This is in accordance with the findings on hardness of final products as affected by different pre-treatments (Askari, *et. al.*, (2006) [9] and Aboubakar, *et. al.*, (2009) [10]. This increase in hardness is might be due to longer time heat treatment and due to extended exposure of slices to heat (Nath, *et. al.*, 2013) [5].

From the results pertaining to the influence of thickness on total colour difference (Δ*E*), a higher value was observed for lower thickness ie 7.3221 where as lower 7.2143 for 4mm thick samples. It may be due to the faster drying rates for lower thickness and resulted in higher values of ΔE as thinner samples reach higher internal temperatures which causes further degradation of carotenoids (Maria, *et. al.*, 2013) [11].

Effect of slice thickness on organoleptic quality parameters

Osmo- convectively dried carrot slices prepared by varying thickness were assessed for different quality parameters viz; colour, appearance, flavour, texture and taste. Data pertaining to organoleptic quality parameters was found statistically significant and presented in figure 2. From the scores, it is cleared that all sample were found acceptable in respect of sensory score obtained for individual characteristic ie. colour, appearance, flavour, texture and taste. Overall acceptability was calculated by considering the average score for all other parameter. However, lowest score of overall acceptability ie 7.78 was observed for the samples prepared by using 2 mm slice thickness and higher score of 8.90 was for 3mm thickness followed by 4mm thick carrot slice. Slices with 2mm thickness being thin were susceptible for breakage during mechanical drying. Sample with 3mm thickness resulted into highest score for all the sensory attributes like colour and appearance, flavour, texture, taste and overall acceptability.

Conclusion

Osmotic dehydration characteristics such as water loss, weight reduction, solid gain and total colour difference decreased with increases in thickness of carrot slice. Hardness of the carrot slices increased with increase in thickness. However 3mm slice thickness was found optimum in respect of overall acceptability for osmo-convectively dried carrot slice.

References

1. Silva Dias, J.C. Nutritional and health benefits of carrots and their seed extracts. Food and Nutrition Sciences. 2014; 5:2147-2156.
2. Ruiz-Cabrera MA, Flores-Gómez G, González-García R, Grajales-Lagunes A, Moscosa- Santillan M, Abud-Archila M. Water diffusivity and quality attributes of fresh and partially osmodehydrated cactus pear (*Opuntia ficus indica*) subjected to air-dehydration international. Journal of Food Properties. 2008; 11:887-900.
3. Singh B, Kumar A, Gupta AK. Study of mass transfer kinetics and effective diffusivity during osmotic dehydration of carrot cubes. J Food Engg. 2007; 79:471-480.
4. Nazni P, Karuna D Thara. Optimization of Beetroot Peel Osmotic dehydration process using response surface methodology. International Journal of Current Research. 2011; 3(8):027-032.

5. Nath, Bidyut C, Deka, Jha AK, Paul D, Misra LK. Effect of slice thickness and blanching time on different quality attributes of instant ginger candy, J Food Sci Technol. 2013; 50(1):197-202.
6. Rastogi NK, Raghavarao KSMS. Water and solute diffusion coefficients of carrot as a function of temperature and concentration. Journal of Food Engg. 1997; 34:429-440.
7. Kolawole O. Falade A, Joseph C, Igbeka B, Funke AA. Kinetics of mass transfer, and colour changes during osmotic dehydration of watermelon, Journal of Food Engineering. 2007; 80:979-985.
8. Rastogi NK, Raghavarao KSMS, Niranjan K, Knorr D. Recent developments in osmotic dehydration: methods to enhance mass transfer, Trends in Food Science and Technology, 2002; 13:48-59
9. Askari GR, Emam-Djomeh Z, Mousavi SM. Effects of combined coating and microwave assisted hot-air drying on the texture, microstructure and rehydration characteristics of apple slices. Food Sci Technol Int; 2006; 12(1):39-46.
10. Aboubakar NY, Njintang JS, Mbofung CMF. Texture, microstructure and physicochemical characteristics of taro (*Colocasia esculenta*) as influenced by cooking conditions. J Food Engg; 2009; 91(3):373-379.
11. Maria Ocoró-Zamora. Influence of thickness on the drying of papaya puree (*Carica papaya* L.) through refractance windowtm technology. Dyna, Year 80 Medellin, December, Nro. 2013; 182:147-154.