Food ScienTech Journal Vol. 5 (1) 2023 ISSN : 2685-4279 DOI:10.33512/fsj.v5i1.19225

Rehydration Kinetics of Dehydrated Vegetables Pre-Treated By Ohmic-Blanching

Joshua Oheji Otugbeikwu[1,3*], Philip Abraham Aligwe[2], and Julius Amove[3]

[1]Department of Medicinal Chemistry and Quality Control, National Institute for Pharmaceutical Research and Development (NIPRD) Abuja, Nigeria.
[2]Department of Chemical and Material Engineering, New Jersey Institute of Technology, United States of America
[3]Department of Food Science and Technology, Federal University of Agriculture, Makurdi, Nigeria
* E-mail: joshuaoheji@gmail.com

Submitted: 21.02.2023; Revised: 19.06.2023; Accepted: 26.06.2023

ABSTRACT

Dehydration is an irreversible process resulting in the loss of structural integrity and rehydration capacity (RC) of food products. Pretreatment methods are used to condition the tissue of vegetables for dehydration to reduce its effect on the structural integrity of the products. In this study, we investigated the effect of ohmic blanching as a pretreatment method and compared it with water blanching and microwave blanching. The Peleg model was used to evaluate the rehydration properties through regression analysis. The model was satisfactorily fitted with the data. However, there was a model deviation with water-blanched potato and yam. Dehydrated products pretreated by ohmic blanching compared favorably with microwave-blanching in carrots, potatoes, and yams. The RC ranged between 264.04% to 449%, 141.40% to 274.32%, and 70.46% to 155.54% in ohmic-blanched carrots, potatoes, and yams respectively. The application of ohmic blanching in the pretreatment of vegetables showed the potential of producing dehydrated products with better rehydration properties. We have suggested through this study, an improved method of hot air dehydration which was of lower cost compared to freeze-drying. The design and model of a bench-top ohmic heating device provided a portable, simple, and low-cost alternative to the otherwise more capital-intensive equipment designs.

Keywords: Ohmic-blanching, rehydration-kinetics, kinetic-model, moisture absorption

INTRODUCTION

The purpose of dehydration is to reduce the moisture content of food products to low enough levels for the prevention of spoilage due to microbial activities as well as biochemical and physical changes. Dehydration is also applied in minimally processed foods which have become important not only in food preservation given the recent demand for convenience in food preparations. However, studies (Lopez-Quiroga et al., 2019; Okpala and Ekechi, 2014; Rana et al., 2021) have underlined the difficulty of rehydration, given the need for the rehydration of food products before consumption by the final consumer. This is a result of microstructural damage due to modified cell crystallinity, middle lamella, and clumped microfibrils during dehydration. As a result, research attention has been given to drying pretreatment methods in a bid to improve the rehydration properties of dehydrated food products as well as to conserve energy consumption and reduce drying time (Rana et al., 2021).

Blanching is a minimal heat treatment of primarily solid food products (fruits and vegetables) to inactivate enzymes (Xiao et al., 2017). Blanching is also applied as a drying pretreatment. The moist heat opens up the pores of the food material thereby conditioning the tissue for moisture absorption by capillary action (Xiao et al., 2017). Steam, water, ultrasonic, and microwave blanching (Cheng et al., 2015; Rana et al., 2021) has been used applied in drying pretreatment. However, no literature has reported the effect of ohmic blanching as a drying pretreatment method on the rehydration properties of vegetables.

Ohmic heating is the passage of alternating current through a food material. The process ignores the effect of temperature gradient in convectional heat transfer resulting in rapid and uniform heating due to reactor fluctuation of electric fields (Indiarto and Rezaharsamto, 2020). The equipment design varies but consists fundamentally of a heating chamber, a pair of electrodes, and an alternating current source (Indiarto and Rezaharsamto, 2020). Ohmic blanching of solid food is carried out by dispersing the food materials in a carrier fluid usually containing 0.15 – 1.5% w/w NaCl (Zhu et al., 2010). (Rao et al., 2014) observed that dispersed food products pretreated in this method heated more uniformly during ohmic heating. The choice of ohmic heating in this experiment is due to its ability to heat the food materials rapidly, and uniformly (Deng et al., 2019; Sakr and Liu, 2014), ensuring that the product is thoroughly blanched. As a result, there would be minimal damage to the tissues of the food products. Ohmic heating is rapid and efficient which could reduce the processing time, cut down processing costs and increase efficiency (Xiao et al., 2017).

Guida et al. (2013) investigated the effect of ohmic and conventional blanching on the nutritional, bioactive compounds and quality parameters of artichoke heads. It was observed that ohmic blanching inactivated spoilage enzymes at a lower blanching time and preserved the colour and texture of the products while also retaining more protein and phenolic compounds (Guida et al., 2013). Ohmic blanching of carrots, red beet and golden carrots resulted in greater softening rates and weight losses compared to those blanched in hot water and microwave (Xiao et al., 2017). The combination of ohmic heating and vacuum impregnation was found to improve mass transfer during the osmotic dehydration of strawberries (Xiao et al., 2017).

The objective of this work was to study the effect of ohmic blanching as a drying pretreatment on the rehydration properties of carrots, potatoes, and yams. We applied the Peleg model to describe the moisture absorption process. Previous reports (Lopez-Quiroga et al., 2019) have shown the suitability of the model in predicting the equilibrium moisture content (X_{eq}) over short soaking periods.

MATERIALS AND METHODS

The food materials (yam, potato, and carrot) were purchased from a local market in Abuja, Nigeria. The food materials were washed thoroughly to remove adhering soils. Yams were peeled and cut into slices, potatoes were peeled and cut into the shape of french fries while carrots were cut into cylindrical shapes. All slices and cuts were 20mm thick. All food samples were grouped into five. A group was left unblanched to serve as the control. The moisture content of the fresh food materials was determined according to the AOAC described in (Okpala and Ekechi, 2014).

Ohmic heating device

A table-top ohmic heating device for batch processing applications was designed. Using the isometric grid system described by (Otukoya, 2022) a 3D model was developed. A prototype of the design was fabricated with a wooden frame surrounding a plastic heating vessel and a pair of aluminum plate electrodes. The device was equipped with a digital kitchen thermometer (Model KBT010001, China) having a stainless-steel probe capable of measuring -50°C to + 300°C as shown in Figure 1.

Water-blanching

The food materials were submerged in hot water in a 1:10 material-to-water ratio for 2 minutes after heating to a temperature of 90°C on a hot plate (Rana et al., 2021).

Microwave-blanching

Food materials were placed in a polyethylene terephthalate plate in a microwave oven (Sony-25 Liters, China) at 650 watts for 2 minutes as previously described by (Rana et al., 2021).

Ohmic blanching

Ohmic blanching was carried out according to previously reported methods Zhu *et al.*, 2010). Briefly, the food materials were dispersed in 1% NaCl solution (carrier fluid) in the heating chamber of the ohmic heating device. AC voltage of 230 volts was applied for test periods of 1 minute and 2 minutes.

Dehydration

Adopting the procedures followed by (Lopez-Quiroga et al., 2019; Lopez-Quiroga et al., 2020) with few modifications, all samples were dried at 70°C in a vacuum oven (Model No. DHG-9101-0SA, China) to a constant weight. The samples were spread uniformly on an aluminum drying tray and placed in the oven after preheating to 70°C.

Rehydration

The initial moisture contents of dehydrated vegetable samples were determined according to the AOAC as the method described in (Chen et al., 2016) followed by a series of rehydration experiments according to previously reported methods (Lopez-Quiroga et al., 2019; Rana et al., 2021). The food samples were immersed in distilled water in a beaker at 40, 60, and 80°C and removed at intervals (30 minutes for the first 3 hours followed by an hourly interval until equilibrium), blotted with tissue paper to dry out surface water, and reweighed. High rehydration temperatures were chosen to sufficiently examine the effect of pretreatment methods on the structural integrity of the vegetable samples.

Rehydration modelling

The Peleg model was chosen due to its suitability in predicting the equilibrium moisture contents over short rehydration periods. The Peleg model (Lopez-Quiroga et al., 2020) describes the moisture content (dry basis) as follows;

$$X(t) = X_0 + \frac{t}{k_1 - k_2 t} \qquad (1)$$

where *t* (in minutes) is time, X_0 is the initial moisture content on dry basis (d.b), k_1 is the Peleg rate constant and k_2 is the Peleg capacity constant. Peleg capacity constant k_2 (Lopez-Quiroga et al., 2020) is related to the equilibrium moisture content;

$$X_{eq} = X_0 + \frac{1}{k_2} \qquad (2)$$

Rehydration capacity (RC) (Lopez-Quiroga et al., 2020) was calculated as;

$$RC(\%) = \frac{X_f - X_i}{X_f} \times 100\% \qquad (3)$$

Where X_f is the moisture content at saturation and X_i is the initial moisture content of the dried samples (Lopez-Quiroga et al., 2020).

All experiments were performed in triplicates. Mean moisture contents were used to fit the Peleg kinetic model. R^2 and mean moisture contents and standard deviations were calculated in Microsoft Excel 2016.

RESULTS AND DISCUSSION

Moisture Content

The moisture contents of carrots, potatoes, and yams before and after dehydration are shown in Table 1. The pretreatment with microwave and ohmic blanching resulted in relatively higher moisture reduction at the end of the drying process compared to unblanched and water-blanched food materials. This observation supports the previous report of (Rana et al., 2021) with microwave blanching drying pretreatment.

Rehydration properties of dehydrated vegetables

The rehydration curves for dehydrated carrot, potato, and yam showing the absorption of moisture in kg moisture/kg dry matter per hour are presented in Figures 2 – 4. Moisture absorption was greatest at 60°C and least at 40°C for most blanching methods as well as the unblanched carrots. The moisture absorption of dehydrated potatoes was greater at 80°C for all pretreatment methods with the exception of unblanched potatoes. Ohmic blanching at one minute resulted in higher moisture absorption of dehydrated yams at 80°C. There was an increase in rehydration with an increase in rehydration temperature of yams pretreated by blanching for 1 minute in ohmic heat. Previous studies (Lopez-Quiroga et al., 2020; Rana et al., 2021) revealed greater moisture absorption at higher rehydration temperatures. The higher rate of moisture absorption at higher temperatures of the rehydration medium could be a result increased mass transfer (Xiao et al., 2017).

Moisture absorption in carrot and yam was greater at 80°C in the early stages of rehydration. As rehydration time increased, the moisture absorption gradually decreased. This suggests that the heat may have caused irreversible changes at 80°C. It is reported that above 60°C, starch may undergo some irreversible reactions like gelatinization and retrogradation (Chhe et al., 2018; Tako et al., 2014) in the presence of moisture. Thereby resulting in an early and lower saturation time and moisture content respectively.

The corresponding points of saturation in carrots at 80°C and 60°C rehydration temperature were closer in the ohmic blanched samples. Thus, ohmic heating may have caused minimal damage to the tissue of carrots. Similarly, at 1 minute of blanching in ohmic heat, rehydration was significantly higher in yams. Moreover, (Indiarto and Rezaharsamto, 2020) revealed that the generally low conductivity of food products enhances uniform heat distribution, causing less damage to the tissue.

Rehydration Kinetics of dehydrated vegetables

Peleg's kinetic model parameters are presented in Tables. The Peleg model was satisfactorily fitted with the experimental data with observed deviations in water-blanched potatoes and yams. The regression coefficients calculated from model fitting ranged from 0.7279 to 0.9840 for carrots, 0.5652 to 0.9875 for potatoes, and 0.4533 to 0.9965 for yam. The low regression coefficients observed in water-blanched yams and potatoes resulted from an irregular rehydration pattern with an observed loss of mass along with moisture absorption. The loss of mass was probably due to starch solubility in water. The granular structure of starch is usually lost as a result of gelatinization as starch molecules get dispersed in water (Chakraborty et al., 2022). Particles of yam and potato were observed to leach into the rehydrating medium (hot water). However, this was not apparent in all other treatments. The unblanched food materials absorbed water minimally and attained an equilibrium moisture content between 0.86 kg/kg and 1.41 kg/kg with minimal leaching.

The Peleg's rate constant is related to the rate of water absorption in food samples. The relatively lower k_1 values correlate with higher initial water absorption rates (Okpala and Ekechi, 2014). The non-linear variation of k_1 with rehydration temperature observed in previous studies was discussed by (Miano and Augusto, 2018; Oli et al., 2014). Except for hot water-blanched carrots where there was a decreasing trend with increasing rehydration temperature, k_1 was greatest at 60°C with an increase from 40°C followed by a decrease at 80°C. Also, the Peleg's rate constant decreased significantly with an increase in the rehydration temperature of hot water-blanched potato. At 60°C, k_1 was greatest in unblanched, microwave-blanched, and ohmic-blanched potatoes. In yams, k_1 increased with increasing rehydration temperature in unblanched and microwave-blanched yams. The Peleg's rate constant was greatest at 40°C rehydration temperature in ohmic-blanched yams. Moreover, several researchers (Lopez-Quiroga *et al.*, 2019; Indiarto and Rezaharsamto, 2020; Rana *et al.*, 2021) have previously revealed and confirmed the temperature dependence of k_1. In the current study, it was found that k_1 is not only dependent on rehydration temperature but also on the blanching method used as a pretreatment which implies that k_1 is affected by the effect of microstructural damage on the rehydrating food sample.

Lower k_2 corresponds to higher water absorption capacity (Miano and Augusto, 2018). The variation in k_2 with temperature was not linear. The effect of temperature on water absorption capacity (k_2) is variable, depending on the nature of the material (Oli et al., 2014). The loss of soluble solids during soaking may affect the moisture absorption capacity of the food material (Oli et al., 2014).

The saturation moisture content of the food materials has not reached the moisture content of the fresh products indicating that dehydration is irreversible. This observation supports previous reports (Lopez-Quiroga *et al.*, 2019; Rana *et al.*, 2021). The predicted equilibrium moisture contents (X_{eq}) were lower than the moisture content at saturation (X_f). The rehydration capacities revealed that the dehydrated potato was able to rehydrate up to 299.55% of its mass when blanched in microwave heat. Ohmic blanching of potato for a period of 2 minutes rehydrated to 274.32% and 241.43% (80°C and 60°C rehydration temperature respectively). Microwave blanched yams had the highest rehydration capacity (200.06%) at 60°C rehydration temperature. Moisture absorption capacity (k_2) was high in water-blanched potato and yam, this was followed by a simultaneous mass loss and moisture absorption during soaking. The relatively high equilibrium moisture content (X_{eq}) could be a result of water emptying from the free capillary and intermicellar spaces of the tissue of the yams and potatoes thereby, creating a concentration gradient for more absorption as observed by Sayar, Turhan and Gunasekaran (Miano and Augusto, 2018; Oli et al., 2014). As a result, saturation moisture content was not confirmed as the experiment couldn't be continued due to material disintegration. Microwave and ohmic heat treatments showed little signs of leaching with yam samples remaining intact throughout the period of rehydration. It was previously concluded that ohmic blanching was unsuitable in carrots due to the structural destruction of material tissue (Xiao et al., 2017). However, our results from rehydration experiments show that despite progressive shrinking, the carrot cylinders recovered 424.02% and 411.64% of its mass.

CONCLUSION

The Peleg model was satisfactorily fitted with the experimental data with deviations observed in water-blanched potatoes and yams. Moisture absorption in water-blanched yam and potato proceeded with simultaneous mass losses due to porous capillaries caused by hot water-blanching. The rehydration capacities (RC) of dehydrated carrots were higher than those of potato and yam. Pretreatment of vegetables by blanching in ohmic heat had a satisfactory impact on the rehydration properties as observed in this study.

REFERENCES

Chakraborty, I., N, P., Mal, S.S., Paul, U.C., Rahman, Md.H., Mazumder, N., 2022. An Insight into the Gelatinization Properties Influencing the Modified Starches Used in Food Industry: A review. Food Bioprocess Technol. 15, 1195–1223. https://doi.org/10.1007/s11947-022-02761-z

Chen, Z.-G., Guo, X.-Y., Wu, T., 2016. A novel dehydration technique for carrot slices implementing ultrasound and vacuum drying methods. Ultrason. Sonochem. 30, 28–34. https://doi.org/10.1016/j.ultsonch.2015.11.026

Cheng, L.-S., Fang, S., Ruan, M.-L., 2015. Influence of Blanching Pretreatment on the Drying Characteristics of Cherry Tomato and Mathematical Modeling. Int. J. Food Eng. 11, 265–274. https://doi.org/10.1515/ijfe-2014-0218

Chhe, C., Imaizumi, T., Tanaka, F., Uchino, T., 2018. Effects of hot-water blanching on the biological and physicochemical properties of sweet potato slices. Eng. Agric. Environ. Food 11, 19–24. https://doi.org/10.1016/j.eaef.2017.10.002

Deng, L.-Z., Mujumdar, A.S., Zhang, Q., Yang, X.-H., Wang, J., Zheng, Z.-A., Gao, Z.-J., Xiao, H.-W., 2019. Chemical and physical pretreatments of fruits and vegetables: Effects on drying characteristics and quality attributes – a comprehensive review. Crit. Rev. Food Sci. Nutr. 59, 1408–1432. https://doi.org/10.1080/10408398.2017.1409192

Guida, V., Ferrari, G., Pataro, G., Chambery, A., Di Maro, A., Parente, A., 2013. The effects of ohmic and conventional blanching on the nutritional, bioactive compounds and quality parameters of artichoke heads. LWT - Food Sci. Technol. 53, 569–579. https://doi.org/10.1016/j.lwt.2013.04.006

Indiarto, R., Rezaharsamto, B., 2020. A Review On Ohmic Heating And Its Use In Food 9, 6.

Lopez-Quiroga, E., Prosapio, V., Fryer, P.J., Norton, I.T., Bakalis, S., 2020. Model discrimination for drying and rehydration kinetics of freeze-dried tomatoes. J. Food Process Eng. 43. https://doi.org/10.1111/jfpe.13192

Lopez-Quiroga, E., Prosapio, V., Fryer, P.J., Norton, I.T., Bakalis, S., 2019. A model-based study of rehydration kinetics in freeze-dried tomatoes. Energy Procedia 161, 75–82. https://doi.org/10.1016/j.egypro.2019.02.060

Miano, A.C., Augusto, P.E.D., 2018. The Hydration of Grains: A Critical Review from Description of Phenomena to Process Improvements: Hydration of grains: a review…. Compr. Rev. Food Sci. Food Saf. 17, 352–370.

https://doi.org/10.1111/1541-4337.12328
Okpala, L.C., Ekechi, C.A., 2014. Rehydration characteristics of dehydrated West African pepper (Piper guineense) leaves. Food Sci. Nutr. 2, 664–668. https://doi.org/10.1002/fsn3.149
Oli, P., Ward, R., Adhikari, B., Torley, P., 2014. Parboiled rice: Understanding from a materials science approach. J. Food Eng. 124, 173–183. https://doi.org/10.1016/j.jfoodeng.2013.09.010
Otukoya, I., 2022. Welcome to the Isometric Grid. Medium. URL https://iotukoya.medium.com/welcome-to-the-isometric-grid-3b7962440b08 (accessed 9.11.22).
Rana, M.R., Sakib, K.N., Islam, M.Z., Das, P.C., Ara, R., 2021. Effect of pretreatments and temperature on rehydration kinetics of naga chili (Capsicum chinense). Food Res. 5, 38–46. https://doi.org/10.26656/fr.2017.5(4).725
Rao, M.A., Rizvi, S.S.H., Datta, A.K., Ahmed, J., 2014. Engineering Properties of Foods. CRC Press.
Sakr, M., Liu, S., 2014. A comprehensive review on applications of ohmic heating (OH). Renew. Sustain. Energy Rev. 39, 262–269. https://doi.org/10.1016/j.rser.2014.07.061
Tako, M., Tamaki, Y., Teruya, T., Takeda, Y., 2014. The Principles of Starch Gelatinization and Retrogradation. Food Nutr. Sci. 05, 280–291. https://doi.org/10.4236/fns.2014.53035
Xiao, H.-W., Pan, Z., Deng, L.-Z., El-Mashad, H.M., Yang, X.-H., Mujumdar, A.S., Gao, Z.-J., Zhang, Q., 2017. Recent developments and trends in thermal blanching – A comprehensive review. Inf. Process. Agric. 4, 101–127. https://doi.org/10.1016/j.inpa.2017.02.001
Zhu, S.M., Zareifard, M.R., Chen, C.R., Marcotte, M., Grabowski, S., 2010. Electrical conductivity of particle–fluid mixtures in ohmic heating: Measurement and simulation. Food Res. Int. 43, 1666–1672. https://doi.org/10.1016/j.foodres.2010.05.009

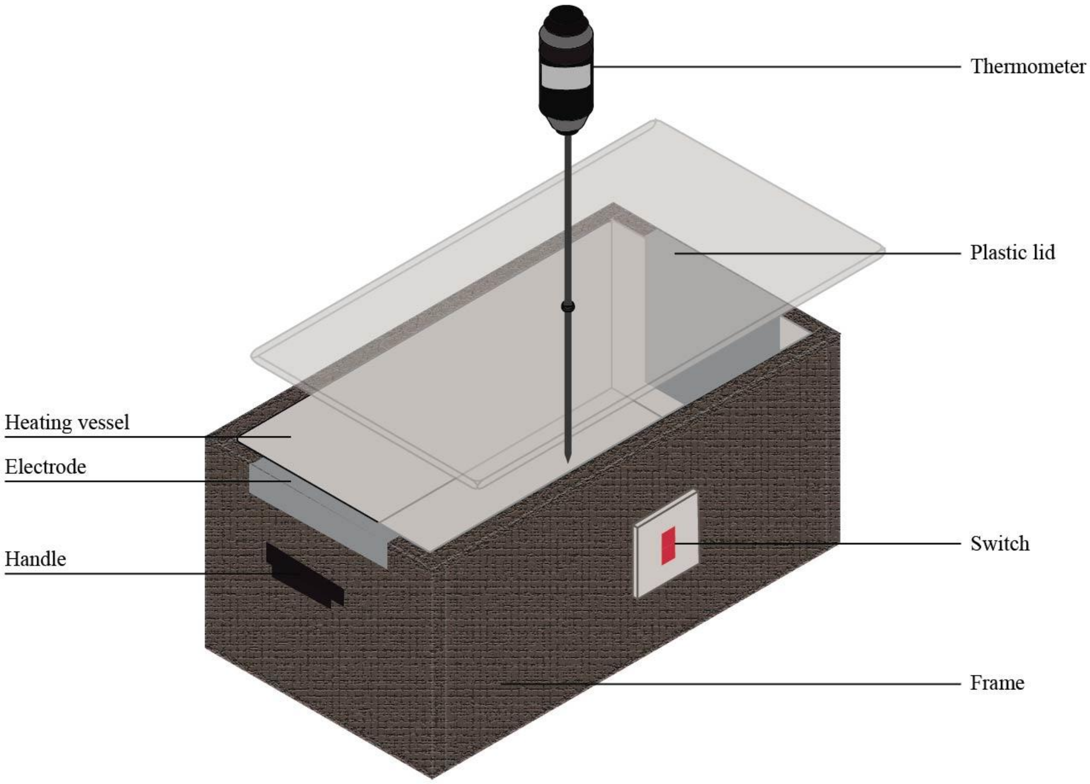
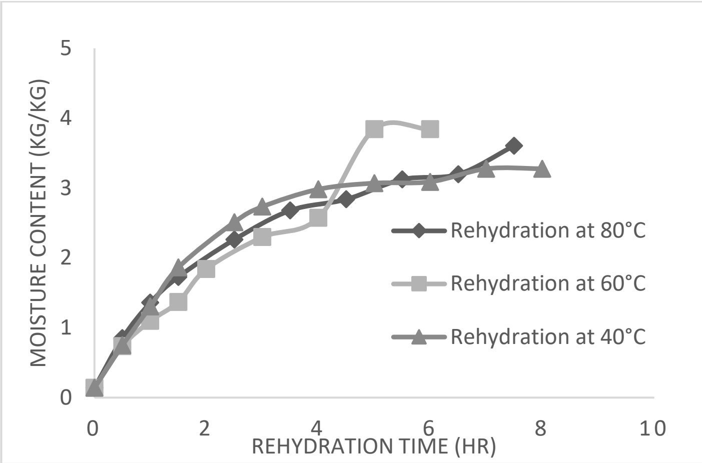
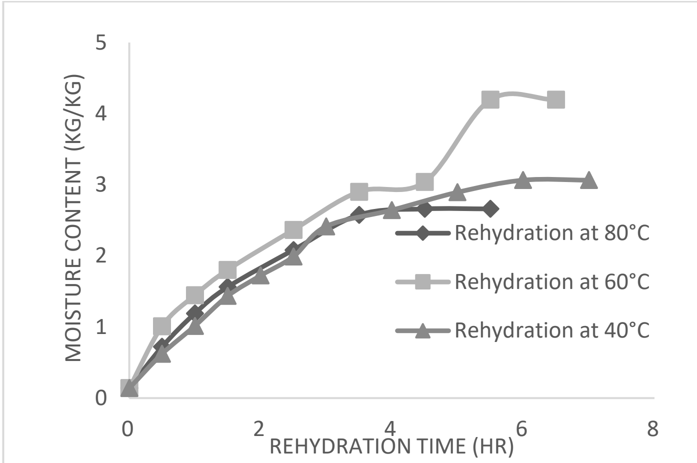


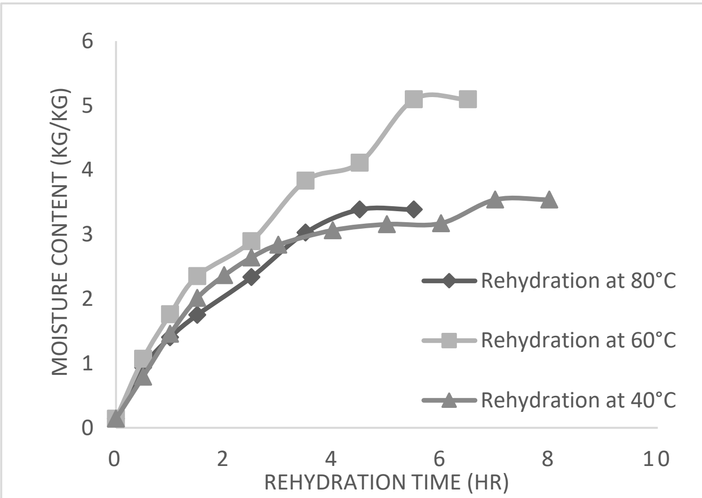
Figure 1. 3D Model of Bench-top Ohmic heating device



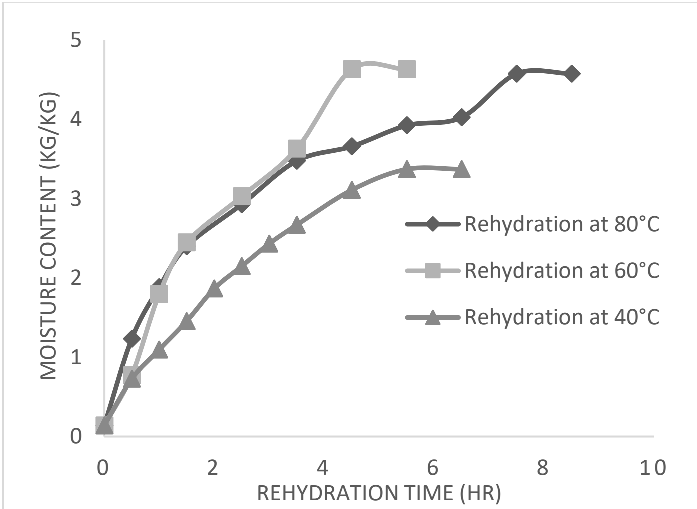
(a)



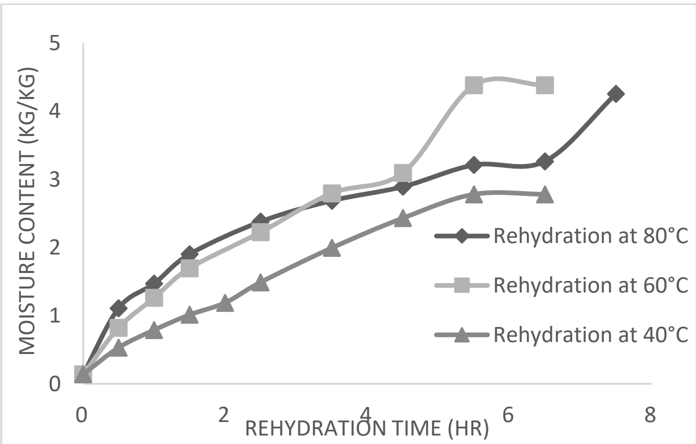
(b)



(c)



(d)



(e)

Figure 2. Rehydration curves of dehydrated carrots (a) unpretreated (b) water blanched (c) Microwave blanched (d) 1 minute blanching in ohmic heat and (e) 2 minutes blanching in ohmic heat.

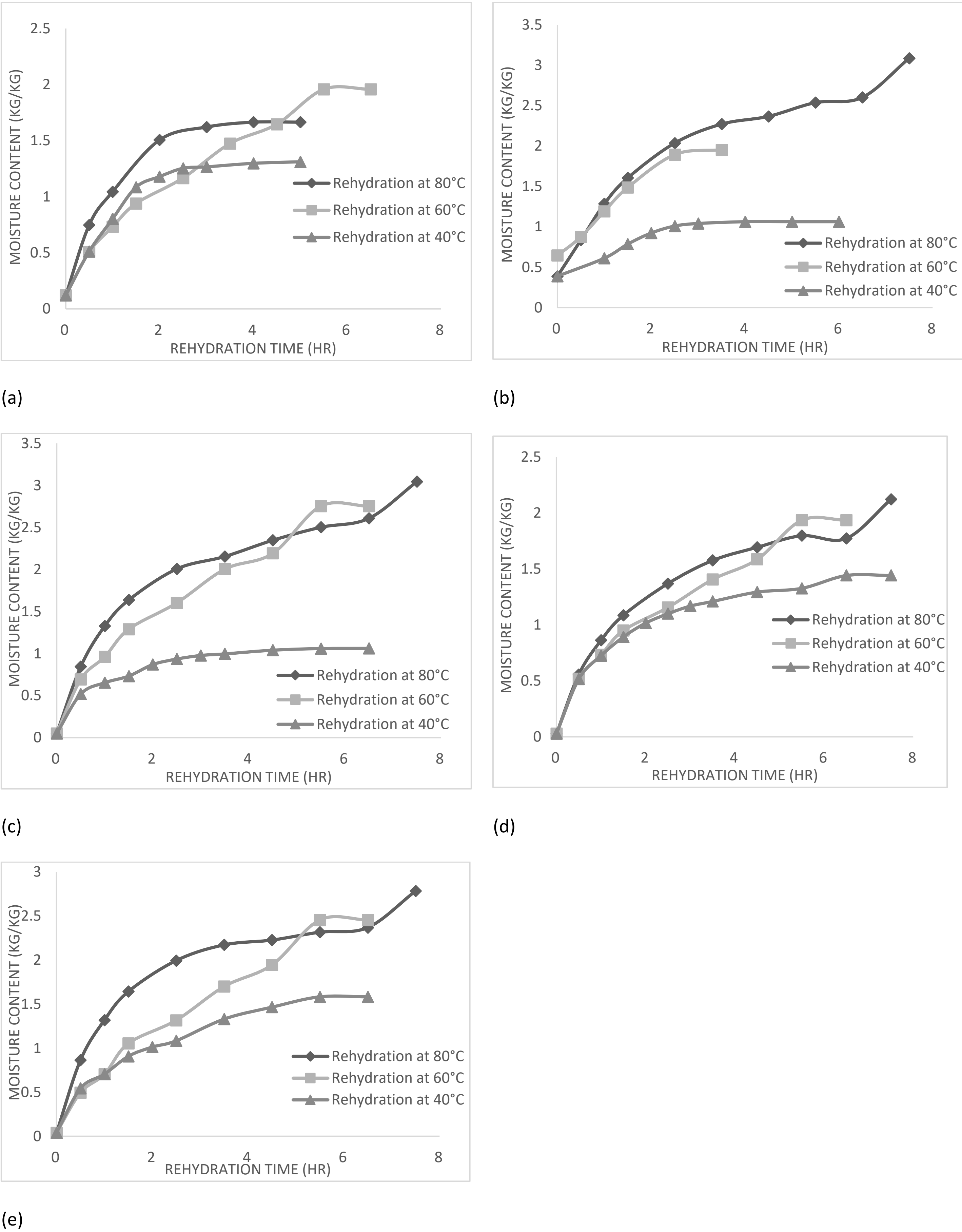
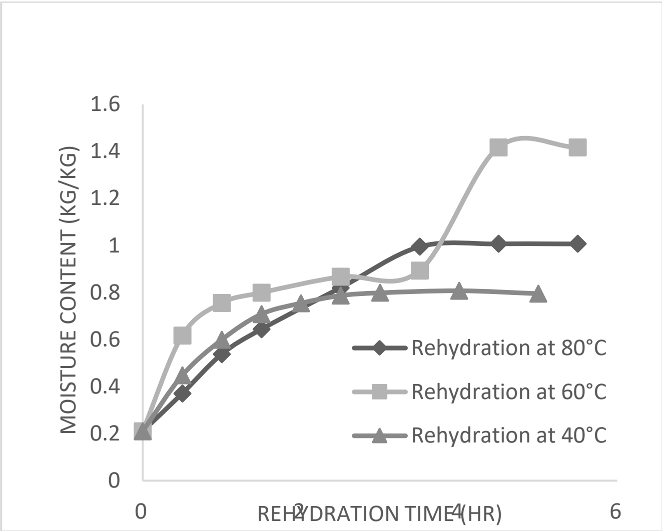
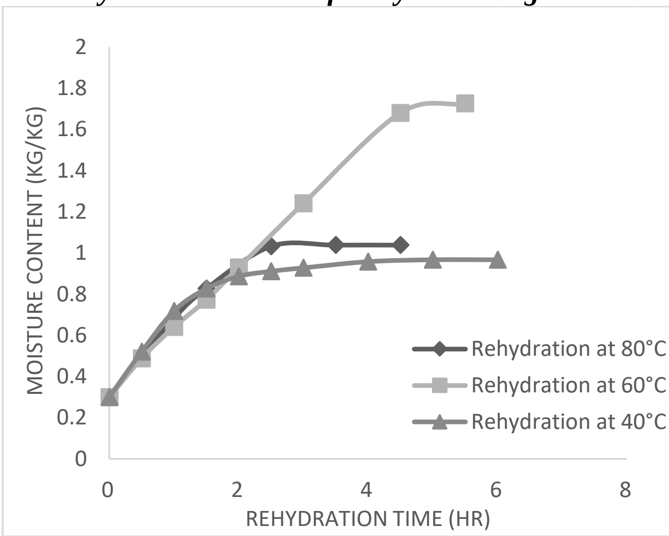


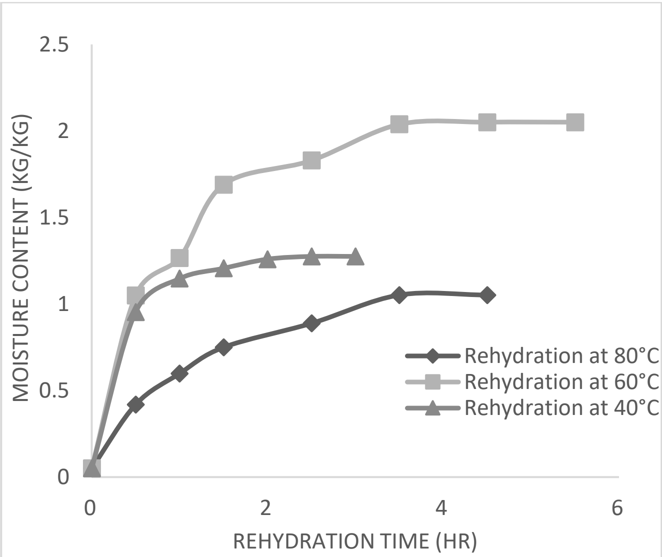
Figure 3. Rehydration curves of dehydrated potato (a) unpretreated (b) water blanched (c) Microwave blanched (d) 1 minute blanching in ohmic heat and (e) 2 minutes blanching in ohmic heat.



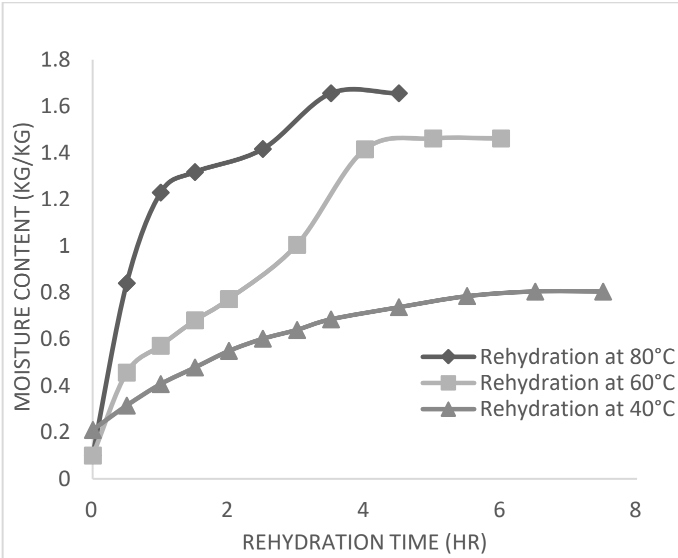
(a)



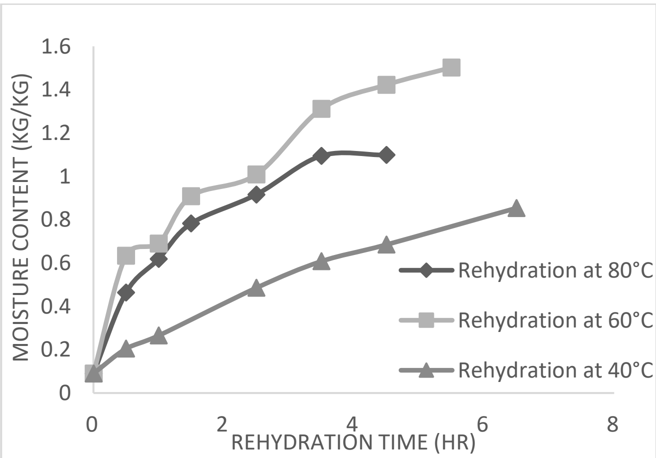
(b)



(c)



(d)



(e)

Figure 4. Rehydration curves of dehydrated yam (a) unpretreated (b) water blanched (c) Microwave blanched (d) 1 minute blanching in ohmic heat and (e) 2 minutes blanching in ohmic heat.

Table 1. Moisture content of fresh and dried food materials

	Initial Moisture Content (kg/kg)			Final Moisture Content (kg/kg)		
	Carrot	**Potato**	**Yam**	**Carrot**	**Potato**	**Yam**
CON				0.160±0.028	0.123±0.025	0.216±0.020
WB				0.145±0.007	0.385±0.005	0.390±0.005
MWB	8.320±0.554	4.016±0.217	1.900±0.100	0.023±0.002	0.056±0.005	0.050±0.005
OH1.0				0.024±0.005	0.025±0.005	0.100±0.050
OH2.0				0.027±0.001	0.046±0.007	0.090±0.010

Key:
CON: Control
WB: Water blanched
OH1.0: Ohmic blanched for 1 minute.
OH2.0: Ohmic blanched for 2 minutes.

Table 2. Rehydration Kinetics of Dehydrated Carrots

Pre-treatment Method	Pre-treatment time (mins.)	Rehydration Temperature (°C)	Carrot						Potato						Yam					
			R^2	k_1	k_2	X_e	X_f	RC (%)	R^2	k_1	k_2	X_e	X_f	RC (%)	R^2	k_1	k_2	X_e	X_f	RC (%)
Unblanched	0	40	0.97	0.64	0.26	3.93	3.27	313.64	0.95	0.46	0.73	1.47	1.31	119.19	0.97	0.67	1.53	0.86	0.79	58.5
	0	60	0.72	1.00	0.13	7.59	3.84	370.28	0.85	0.91	0.43	2.43	1.95	183.82	0.76	1.00	0.77	1.49	1.41	120.72
	0	80	0.98	0.75	0.23	4.33	3.6	346.67	0.97	0.29	0.58	1.83	1.66	154.5	0.85	1.58	0.95	1.26	1	79.65
Water blanching	2	40	0.96	0.94	0.22	4.63	3.06	292.5	0.87	1.38	1.21	1.21	1.06	67.4	0.97	0.78	1.35	1.04	0.96	66.73
	2	60	0.86	0.72	0.17	5.87	4.19	405.47	0.56	1.11	0.30	3.67	2.63	224.45	0.45	0.40	0.40	2.76	1.72	142.62
	2	80	0.98	0.80	0.28	3.59	2.66	252.05	0.90	0.33	0.64	1.95	3.08	269.8	0.84	1.46	1.39	1.01	1.03	73.84
Microwave blanching	2	40	0.97	0.60	0.25	4.14	3.53	339.87	0.98	0.52	0.90	1.15	1.06	101.19	0.99	0.08	0.79	1.31	1.27	122.5
	2	60	0.93	0.58	0.13	7.55	5.09	495.51	0.86	0.58	0.30	3.32	2.75	270.37	0.98	0.20	0.46	2.61	2.05	200.06
	2	80	0.96	0.69	0.21	4.72	3.38	324.53	0.95	0.39	0.32	3.15	3.04	299.55	0.94	0.63	0.87	1.59	1.05	100.19
Ohmic heating	1	40	0.97	0.88	0.18	5.43	3.37	323.14	0.97	0.62	0.64	1.58	1.44	141.4	0.89	2.90	1.28	0.87	0.8	70.46
	1	60	0.80	0.64	0.11	8.5	4.63	449.24	0.89	0.74	0.44	2.28	1.93	190.76	0.79	1.18	0.56	1.88	1.46	136.17
	1	80	0.98	0.52	0.19	5.29	4.57	443.71	0.95	0.58	0.45	2.24	2.12	209.38	0.97	0.24	0.60	1.76	1.65	155.54
	2	40	0.87	1.46	0.16	6.08	2.78	264.04	0.94	0.70	0.55	1.83	1.58	154.21	0.69	2.99	0.98	1.02	0.85	76.37
	2	60	0.79	0.86	0.13	7.65	4.38	424.04	0.78	0.83	0.31	3.22	2.45	241.43	0.92	0.66	0.63	1.59	1.5	141.19
	2	80	0.90	0.68	0.2255	4.57	4.25	411.64	0.96	0.33	0.3595	2.82	2.78	274.32	0.941	0.6644	0.86	1.16	1.09	100.81