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DETERMINATION OF SUITABLE OSMOTIC SOLUTION CONCENTRATION AND TIME FOR OSMOTIC DEHYDRATION OF PAPAYA SLICES

Mahendranathan M.[1], Prasantha B. D. R.[2], Hettiarachchi D. N.[3].

Postgraduate Institute of Agriculture, University of Peradeniya, , Department of Food science and Technology,Faculty of Agriculture, University of Peradeniya, ,Food research unit,Department of Agriculture,Gannoruwa.

Abstract

Osmotic dehydration has been used as a long term preservation method for papaya slices. This study was done to determine suitable sugar concentration and time for osmotic dehydration of papaya. In this study papaya slices (50×50×5 mm) were blanched for three minutes, then pre weighed pieces were dipped into 40^{o} Brix, 50^{o} Brix, and 60^{o} Brix sugar solutions for four hours and weighed every 30 minutes with 15 minutes interval manual agitation. Based on the rate of weight changes, suitable concentration of sugar solution was selected. During the process mean percentage weight loss of papaya were increased with time. Significant differences of mean weight loss of papaya were not observed in sugar concentrations 50^{o} and 60^{o} Brix. Whereas it showed significant difference with 40^{o} Brix, while all other conditions were maintained constant. Due to case hardening effect and high cost of production 60^{o} Brix was rejected. Result of this study proved that 50^{o} Brix for four hours period is the suitable condition for the effective osmotic dehydration of papaya slices.

Key words: Osmotic dehydration, Papaya, sugar concentration

Introduction

The increased interest in and demand for organic products also affects the consumption of organic dried fruits. In recent past agriculture through production of dehydrated fruits and vegetables has captured a good market and became a good source of foreign exchange earnings. The annual growth of dried fruit import value of United Kingdom is significantly higher from developing countries than imports from other countries [1]. Dried fruit is mainly used as a snack for breakfast cereals, muesli, bakery products, dairy products and dessert.

Sri Lanka produces around 540,000 metric tons of fruits annually [2], but amount of postharvest loss is very high. Annually around 35-40% losses of fruits and vegetables occur under traditional distribution chain [3]. Annual loss of papaya is 40% [4]. This amount of postharvest losses occur due to the lack of appropriate packaging methods to transport from farm gate to the consumer, and the poor packaging storage methods transport facilities. Additionally, involvement of many middlemen such as retailers and whole sellers in the supply chain also contributes to these losses. Water removal from fruit and vegetables by drying is one of the oldest forms of food preservation known to man and is the most important process to preserve food [5]. Water, being one of the main food components, has a decisive direct influence on the quality and durability of food stuffs through its effect on many physicochemical and biological changes. Water removal is the main task while preserving food [6] reducing the moisture contents to a level, which allows safe storage over an extended period of time. Dried foods also present low storage and transportation cost when compared to the fresh ones [7].

Recently, osmotic dehydration has been introduced as a practical alternative preservation approach that is capable of producing a higher quality final product [8]. In osmotic dehydration, fresh produce is immersed in a hypertonic solution where the water content from the cells of the produce is transferred into the solution due to the relative differences in their solute concentrations [8]. In this processing, osmotic dehydration removes a desired portion of thewater from within the fresh produce resulting in a product of intermediate moisture content [9]. Simultaneously, a corresponding transfer of solid materials (normally sugar and/or salt) occurs from the solution into the product [8, 10]. In fruit osmotic dehydration treatment is use as pretreatment to reduce the quality loss of fresh fruits and increase the organoleptic properties. To use the osmotic dehydration as a pretreatment need to know about osmotic solution concentration and time duration that required to dip within that solution. Thus the whole objective of this research study is to determine the suitable osmotic solution concentration and time for osmotic dehydration of papaya slices.

Materials and Methods

This study was carried out at the food research unit, Department of Agriculture, Gannoruwa and laboratories of faculty of Agriculture Department of Food Science and Technology. Mature fresh Papaw (*Carica papaya*) was selected from local market for the experiment.

Osmotic Dehydration

Selected fruits were washed well with tap water to remove adhering extraneous material and peeled. Then the fruits were cut into five millimeter thickness pieces. The pieces were blanched using steam for three minutes. Those fruit pieces were pre weighed and dipped into different concentration of sugar solutions. Papaya dipped into 40 ^{o}Brix, 50 ^{o}Brix and 60 ^{o}Brix sugar solutions. Then fruit pieces were frequently weighed 30 minutes time intervals. Manual agitation was carried every 15 min interval throughout the test. Based on the rate of weight changes, suitable concentration of sugar solution and time period was selected.

Statistical Analysis

Data obtained for osmotic concentration selection was subjected to one way ANOVA using SPSS 22 statistical software package. Means were compared by least significant difference $P<0.05$.

Results and Discussion

Osmotic Dehydration

Concentration of osmotic agent t can influence on mass transfer kinetics. When fruit pieces were dipped into an osmotic solution, mean percentage weight loss of papaya and pineapple were increased with time, as shown in figure 1.1. All three concentrations of sugar solutions can be used to the purpose of moisture loss and solid gain. However sugar concentration of 50 ^{o} Brix and 60 ^{o} Brix did not show any significant difference ($p>0.05$) of mean weight loss of papaya, whereas it was shown significant difference with 40 ^{o}Brix, while all other conditions were maintained constant. Therefore 50 ^{o}Brix sugar solution was selected as the suitable osmotic concentration for further processing.

Papaya 40 brix

Time (min)	Initial wgt	R1	wgt loss %	Initial wgt	R2	wgt loss %	Initial wgt	R3	wgt loss %	Mean wgt loss %	SD
0	93.57	93.57	0	91.21	91.21	0	93.41	93.41	0	0.00	0.00
30	93.57	93.42	0.160	91.21	91.01	0.219	93.41	93.32	0.096	0.16	0.06
60	93.57	93.31	0.277	91.21	90.69	0.570	93.41	93.03	0.406	0.42	0.15
90	93.57	92.44	1.207	91.21	90.3	0.997	93.41	92.31	1.177	1.13	0.11
120	93.57	92.02	1.656	91.21	88.94	2.488	93.41	91.62	1.916	2.02	0.43
150	93.57	90.5	3.280	91.21	88.25	3.245	93.41	91.14	2.430	2.99	0.48
180	93.57	90.03	3.783	91.21	86.77	4.867	93.41	89.29	4.410	4.35	0.54
210	93.57	88.66	5.247	91.21	86.08	5.624	93.41	88.99	4.731	5.20	0.45
240	93.57	87.75	6.219	91.21	85.12	6.676	93.41	85.93	8.007	6.97	0.93

Papaya 50 brix

Ti me (min)	Initial wgt	R1	wgt loss %	Initial wgt	R2	wgt loss %	Initial wgt	R3	wgt loss %	Mean wgt loss %	SD
0	96.75	96.75	0	89.3	89.3	0	93.41	93.41	0	0.00	0.00
30	96.75	95.14	1.664	89.3	87.38	2.150	93.41	91.29	2.269	2.03	0.32
60	96.75	92.11	4.795	89.3	83.58	6.405	93.41	87.47	6.359	5.85	0.92
90	96.75	90.27	6.697	89.3	81.93	8.253	93.41	86.07	7.857	7.60	0.81
120	96.75	88.71	8.310	89.3	80.11	10.291	93.41	84.61	9.420	9.34	0.99
150	96.75	87.92	9.126	89.3	78.39	12.217	93.41	81.31	12.953	11.43	2.03
180	96.75	86.13	10.976	89.3	75.43	15.531	93.41	79.03	15.394	13.97	2.59
210	96.75	85.2	11.937	89.3	73.31	17.905	93.41	78.49	15.972	15.27	3.05
240	96.75	84.06	13.116	89.3	73.28	17.939	93.41	77.3	17.246	16.10	2.61

Papaya 60 brix

Ti me (min)	Initial wgt	R1	wgt loss %	Initial wgt	R2	wgt loss %	Initial wgt	R3	wgt loss %	Mean wgt loss %	SD
0	90.15	90.15	0	88.41	88.41	0	91.7	91.7	0	0.00	0.00
30	90.15	87.9	2.495	88.41	84.59	4.320	91.7	87.72	4.340	3.72	1.06
60	90.15	84.19	6.611	88.41	81.98	7.272	91.7	81.21	11.439	8.44	2.62
90	90.15	82.53	8.452	88.41	79.24	10.372	91.7	80.02	12.737	10.52	2.15
120	90.15	80.56	10.637	88.41	77.35	12.509	91.7	77.31	15.692	12.95	2.56
150	90.15	78.33	13.111	88.41	74.41	15.835	91.7	72.49	20.948	16.63	3.98
180	90.15	76.57	15.063	88.41	71.27	19.386	91.7	71.13	22.431	18.96	3.70
210	90.15	75.36	16.405	88.41	69.5	21.388	91.7	68.33	25.485	21.09	4.55
240	90.15	72.88	19.156	88.41	69.4	21.502	91.7	67.4	26.499	22.39	3.75

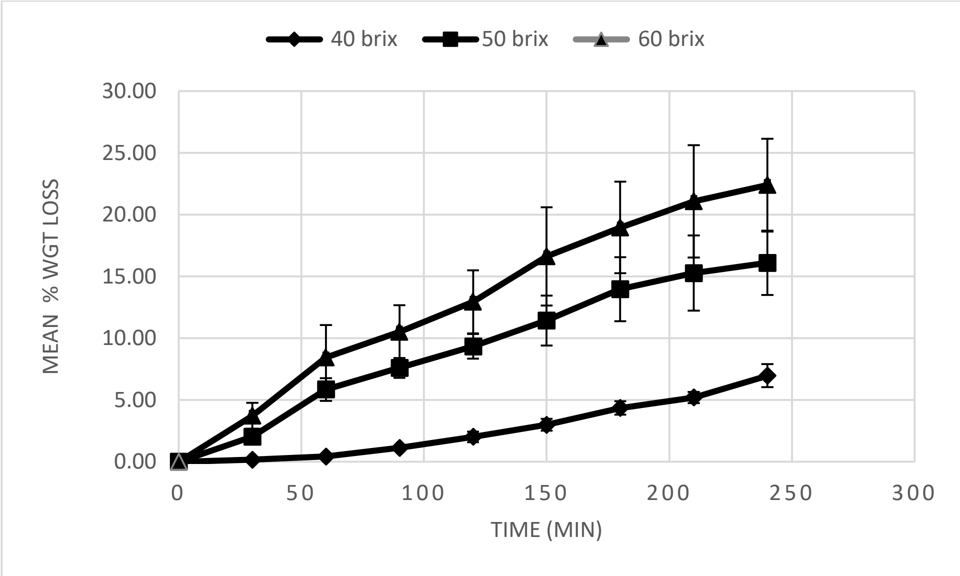

Figure 1.1 Mean percentage weight loss of papaya with time for osmotic dehydration process.

During extended osmotic treatment, the increase of solute concentrations in the fruits as a results of the increase in water loss and solid gain rates [11]. Increase the sucrose concentration enhances the water loss and solid gain throughout the diffusion period [12]. But if osmotic concentration of sugar solution increases above a limit, case hardening effect may become a brier for mass transfer [13], and also increase the cost of production due to the high amount of sugar requirement. Therefore 50 ^{o}Brix sugar solution was selected for the osmotic dehydration.

Conclusion

This study was found that 50^{o} Brix sugar solution is the optimum concentration and four hours is the optimum time duration for osmotic dehydration of papaya slices. Further studies like sensory evaluation, keeping quality testing are essential to optimize the conditions.

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