RESEARCH PAPER | International Journal of Agricultural Engineering | Volume 6 | Issue 2 | October, 2013 | 345–348

Effect of osmotic agent (sugar) on weight loss and solid gain of banana

G.S. PATANGE, P.J. THOKALE AND **P.G. POPALE**

Received : 14.12.2012; **Revised :** 14.09.2013; **Accepted :** 15.10.2013

See end of the Paper for authors' affiliation

Correspondence to :

G.S. PATANGE
Farm Machinery Testing and Training Center, Mahatma Phule Agricultural University, Rahuri, AHMEDNAGAR (M.S.) INDIA
Email : gspatange.iitkgp@gmail.com

ABSTRACT : Osmotic dehydration is the process of removal of water by immersion of water containing cellular solids in a concentrated aqueous solution of sugar or salt. This results in intermediate moisture product with lower water activity. At low water activity, most of chemical reactions, which deteriorate the food, growth and toxins production by microorganism, are ceased. The experiments were conducted to characterize the osmotic dehydration of banana with respect to drying behaviors and the quality of dehydrated product with syrup concentrations (50, 60 and 70^0 B), slice thickness (6mm, 8mm and 10mm) and time of immersion (1 hr interval up to 12 hrs). The fruit to solution ratio was taken as 1:5(w/v). The maximum amount of weight reduction (g) was found at lower concentration 50^0 B for 10 mm slices and minimum amount of weight reduction (g) was found at lower concentration 70^0 B for 6 mm slices. The maximum amount of water reduction 50.97 % was found at 70^0 B and 6 mm thick slices. The minimum amount of water reduction 39.83 % was found at 50^0 B and 10 mm thick slices**.** The minimum amount of solid gain 3 % was found at 50^0 B and 6 mm thick slices. The maximum amount of solid gain 5.81 % was found at 70^0 B and 10 mm thick slices. The maximum amount of weight loss 54.42 % was found at 70^0B and 6 mm thick slices. The minimum amount of weight loss 43.79 % was found at 50^0B and 10 mm thick slices.

KEY WORDS : Osmotic dehydration, Weight loss, Solid gain, Banana

HOW TO CITE THIS PAPER : Patange, G.S., Thokale, P.J. and Popale, P.G. (2013). Effect of osmotic agent (sugar) on weight loss and solid gain of banana. *Internat. J. Agric. Engg.*, **6**(2) : 345-348.

The main objectives of removing water from banana are to improve the keeping quality by reducing water activity and the other object is to reduce the bulk. So it may be economical for handling transportation and distribution. The fruits are preserved as a dehydrated product to store for longer period. The importance of drying permits early harvest, long storage time, a better quality product, etc. Drying is a thermo physical and physico-chemical operation by which excess moisture from product is removed. Drying is simultaneous heat and mass transfer under adiabatic condition (Chaudhari *et al*., 1993). It removes water from food material at appropriate temperature and most suitable rate to retain maximum food values. The effectiveness of a food dehydration process depends on the sufficient moisture reduction to retard chemical deterioration, microbial growth and enzyme activity and without any irreversible reaction removing only free water (Rehman and Lamb, 1990). The permeability of plant tissue is low to sugars and high molecular weight compounds; hence, the material is impregnated with the osmoactive substance in the surface layers only. Water on the other hand, is removed by osmosis and the cell sap is concentrated without a phase transition of the solvent (Lewicki and Lenart, 1995).

Osmotic dehydration is the process of removal of water by immersion of water containing cellular solids in a concentrated aqueous solution of sugar or salt. This results in intermediate moisture product with lower water activity. At low water activity, most of chemical reactions, which deteriorate the food, growth and toxins production by microorganism, are ceased. The effect of osmotic dehydration as a pretreatment is mainly related to the improvement of some nutritional, organoleptic and functional properties of the product. As osmotic dehydration is effective at ambient temperature, heat damage to colour and flavour is minimized and the high concentration of the sugar surrounding fruits and vegetable pieces prevents discoloration. These effects are obtained with a reduced energy input over traditional drying process. The main energy consuming steps in the reconstitution of the diluted osmotic solution is that could be obtained by concentration or by addition of sugar (Rehman and Lamb, 1990). Osmotic dehydration can removed 30 to 40 % moisture from the

product. The amount of water loss taking place during initial period is high and rate solute grain increases. Osmotic dehydration improves colour, flavour and texture, and is less energy intensive process compared air or vacuum drying process as no phase change take place during the moisture removed from the substrate. Several studies were conducted on osmotic dehydration which may focus on effect of osmotic agent and osmotic dehydration (Shedame, 2005; Torreggiani, 1993; Lazarides *et al.*, 1999; Bongirwar and Sreenivasan, 1977). The study planned with objectives to study the effect of osmotic dehydration on weight loss and solid gain of banana.

METHODOLOGY

Pre treatment and experimental design :

The experiments were conducted to characterize the osmotic dehydration of banana with respect to drying behaviors and the quality of dehydrated product. This was done by taking weight of sample at different time interval and measuring quality attributes such a weight loss and solid gain of the material subjected to various process conditions and sensory evaluation of the product was also carried out. Banana of suitable variety were procured from the Banana ripening center. Fully fresh and healthy banana were procured. The banana was washed under tap water for removal of adhering dust and foreign matter. Then raw, sound, banana of suitable variety with the minimum sugar content was chosen. Peeled the fruit and was cut it into slices of 6, 8 and 10mm with a stainless steel knife (ordinary steel knife causes black stains on the slices). Kept the slices in a solution of 0.1 per cent citric acid and 0.1 per cent potassium metabisulphite to avoid browning.

Based on the review of literature and based on the preliminary trials, the parameters selected for osmotic dehydration were syrup concentrations (50, 60 and 70^0 B), slice thickness (6mm, 8mm and 10mm) and time of immersion (1 hr interval up to 12 hrs). The fruit to solution ratio was taken as 1:5(w/v). Sucrose solution was taken as osmotic agent; the hand refractometer was used for measurement of concentration of syrup. In which three concentrations of syrup 50, 60, 70 ^{0}Brix were selected with three slice thicknesses 6, 8, 10 mm to find out moisture content (%), loss of water (%) and solid gain (%). The details of treatment for osmotic dehydration and oven drying are given in Table A and B. Fig. A shows the different stages during the experiment.

Dried bananas were obtained from different methods. Osmotic dehydrated sample of 50, 60 and 70^0 B syrup concentration for 6, 8 and 10 mm thick slices dried at temperature 60, 70 and 80^0C in oven served for sensory evaluation by a panel of 10 semi trained judges according to a method of Amerine *et al.* (1965) on 9 point hedonic scale.

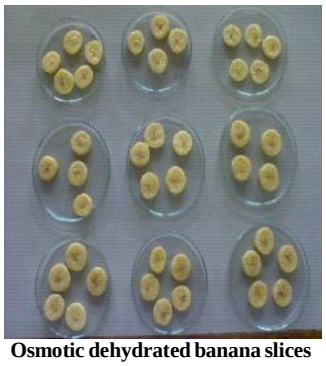
Table A : The details of different treatments are given in table for osmotic dehydration

Sr. No.	Treatments	Syrup concentration ^{0}B (A)	Slice thickness mm (B)
1.	A1B1	50	6
2.	A1B2	50	8
3.	A1B3	50	10
4.	A2B1	60	6
5.	A2B2	60	8
6.	A2B3	60	10
7.	A3B1	70	6
8.	A3B2	70	8
9.	A3B3	70	10

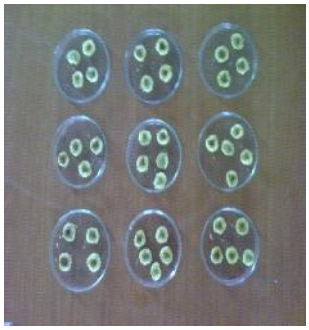
Table B : The details of different treatments are given in table for oven drying

Sr. No.	Treatments	Sample	Drying temperature ^{0}C (C)
1	A1B1C1	A1B1	60
2	A1B2C1	A1B2	60
3	A1B3C1	A1B3	60
4	A2B1C2	A2B1	70
5	A2B2C2	A2B2	70
6	A2B3C2	A2B3	70
7	A3B1C3	A3B1	80
8	A3B2C3	A3B2	80
9	A3B3C3	A3B3	80

Fresh banana



Osmotic dehydrated banana slices



Oven dried banana slices

Banana slices immersed in sugar solution

Fig. A : Different stages of banana during the experiment

At a time all samples were kept for organoleptic evaluation. The average score of 25 judges with different quality characteristics *viz.*, colour, texture, taste and overall acceptability was recorded.

RESULTS AND DISCUSSION

The results of the osmotic dehydration of banana with different concentration of syrup, different thickness of slices and at different time interval were recorded. The sugar solution was used as osmotic agent. The effect of osmotic dehydration parameters, like water loss and solid gain was studied and presented in this section.

Effect of syrup concentration on weight reduction for different banana slices :

The weight reduction at syrup concentration 50^0B for 6 mm, 8 mm and 10 mm thick banana slices varied between 21.05 to 10.49 g, 21.41 to 12.87 g and 21.97 to 13.11 g, respectively. It is presented graphically in Fig. 1. The maximum and minimum weight reduction was found 21.97 g and 10.49 g in 10 mm and 8 mm thick slices, respectively. The weight reduction at syrup concentration 60^0B for 6 mm, 8 mm and 10 mm thick banana slices was from 21.50 to 10.59 g, 21.20 to 11.26 g and 21.66 to 12.91 g. The Fig. 2 shows that, the maximum and minimum weight reduction was found 21.66 g and 10.54 g in 10 mm and 6 mm thick slices, respectively. From Fig. 3, the weight reduction at syrup concentration 70^0B for 6 mm, 8 mm and 10 mm thick Banana slices was from 21.07 to 10.33 g, 21.96 to 10.97 g and 21.44 to 11.85 g, respectively. The maximum and minimum weight reduction was found 22.05 g and 10.33 g in 10 mm and 6 mm thick slices, respectively.

From this, it was concluded that the maximum amount of weight reduction was found at higher concentration 50^0B for 10 mm slices and minimum amount of weight reduction was found at lower concentration 70^0B for 6 mm slices.

– Effect of syrup concentration on water reduction, solid gain and water loss for various.

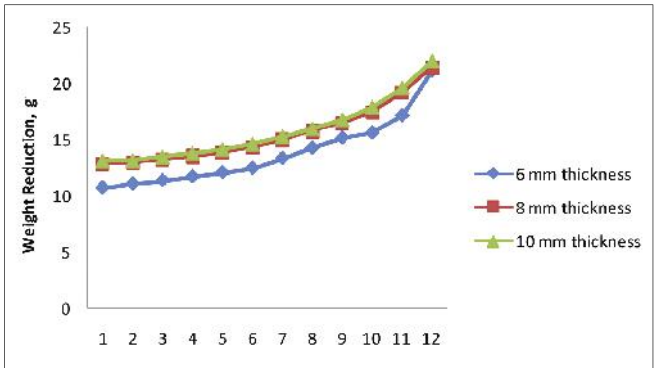


Fig. 1 : Weight reduction at concentration 50^0B for banana slices

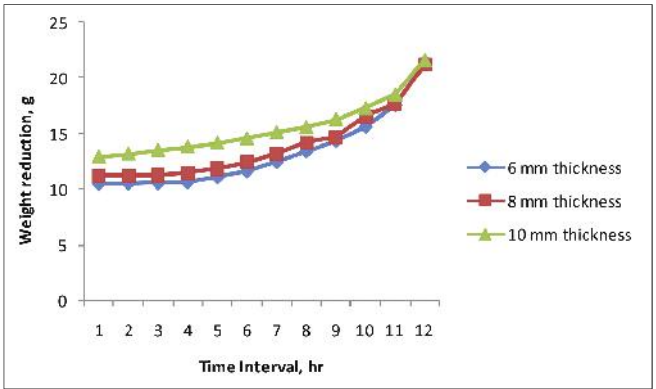


Fig. 2 : Weight reduction at concentration 60^0B for banana slices

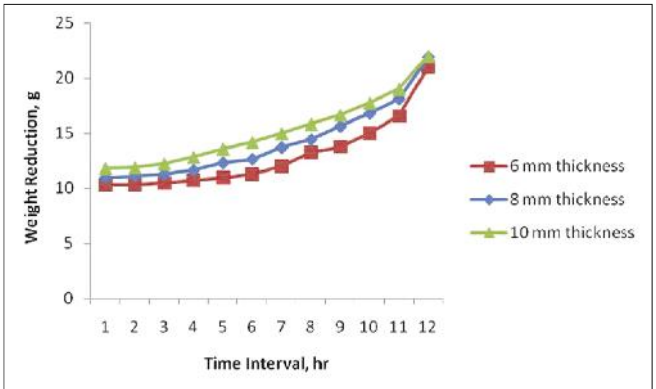


Fig. 3 : Weight reduction at concentration 70^0B for banana slices

Banana slices :

From Table 1, maximum amount of water reduction 50.97 % was found at 70^0B and 6 mm thick slices and the minimum amount of water reduction 39.83 % was found at 50^0B and 10 mm thick slices.

The minimum amount of solid gain 3 % was found at 50^0B and 6 mm thick slices. The maximum amount of solid gain 5.81 % was found at 70^0B and 10 mm thick slices.

The maximum amount of weight loss 54.42 % was found at 70^0 B and 6 mm thick slices. The minimum amount of weight loss 43.79 % was found at 50^0B and 10 mm thick slices.

Sensory evaluation :

The sensory evaluation was done for various organoleptic properties *viz.*, colour, texture, taste and overall acceptability. The average of twenty five evaluators was calculated and data are given tabulated in Table 2. From that, it is found that the overall acceptability for osmotic dehydrated and oven dried banana slices varied between 7.85 and 5.33. Osmotically dehydrated banana slices for concentration 50^0B and thickness of slices is 6 mm gave maximum overall acceptability (7.85) as compared to other.

Table 1 : Effect of syrup concentration on water reduction solid gain and water loss for banana slices

Sr. No	Syrup conc. ^{0}B	Size of sample								
		6mm thick slice			8mm thick slice			10mm thick slice		
		WR	SG	WL	WR	SG	WL	WR	SG	WL
1.	50	49.21	3.00	52.2	39.9	4.00	43.9	39.8	3.96	43.7
2.	60	50.74	3.05	53.7	46.8	4.09	50.9	40.3	5.28	45.6
3.	70	50.97	3.45	54.4	50.0	4.34	54.3	45.9	5.81	51.7

Table 2 : Sensory evaluation of banana slices

Sr. No.	Sample			Colour	Texture	Taste	Overall acceptability
	Syrup conc. ^{0}B	Slice thickness	Drying temp. ^{0}C				
1.	50	6 mm	60	8	7.34	8.22	7.85
2.	60	8 mm	60	7.78	7.45	7.89	7.71
3.	70	10 mm	60	7.34	7.12	7.67	7.38
4.	50	6 mm	70	6.89	6.56	7.33	6.93
5.	60	8 mm	70	6.89	6.89	7.00	6.93
6.	70	10 mm	70	6.89	6.89	7.33	7.03
7.	50	6 mm	80	5.67	5.56	6.22	5.82
8.	60	8 mm	80	5.34	5.78	5.67	5.60
9.	70	10 mm	80	5.34	5.45	5.22	5.33

Conclusion :

Based on results following conclusions are drawn :

– The maximum amount of weight reduction (g) was found at lower concentration 50^0 B for 10 mm slices and minimum amount of weight reduction (g) was found at lower concentration 70^0 B for 6 mm slices.

– The maximum amount of water reduction 50.97 % was found at 70^0 B and 6 mm thick slices. The minimum amount of water reduction 39.83 % was found at 50^0 B and 10 mm thick slices.

– The minimum amount of solid gain 3 % was found at 50^0 B and 6 mm thick slices. The maximum amount of solid gain 5.81 % was found at 70^0 B and 10 mm thick slices.

– The maximum amount of weight loss 54.42 % was found at 70^{0}B and 6 mm thick slices. The minimum amount of weight loss 43.79 % was found at 50^{0}B and 10 mm thick slices.

– The overall acceptability of sample having concentration 50^0 B and 6 mm thickness of slice was maximum (7.85).

Authors' affiliations:

P.J. THOKALE, AICRP on FIM, Mahatma Phule Krishi Vidyapeeth, Rahuri, AHMEDNAGAR (M.S.) INDIA (Email : pthokale@rediffmail.com)

P.G. POPALE, Mahatma Phule Krishi Vidyapeeth, Rahuri, AHMEDNAGAR (M.S.) INDIA (Email : pramod.popale@gmail.com)

REFERENCES

Amerine, M.A., Pangborand, R.H. and Roessler, E.B. (1965). *Principles of sensory evaluation of food.* Academic Press, New York, U.S.A.

Bongirwar, D.R. and Sreeniwasan, A. (1977). Studies on osmotic dehydration of banana. *J. Food Sci. Technol*., **42**(20) : 104-112.

Chaudhari, A.P., Kumbhar, B.K., Singh, B.N.N. and Narain, M. (1993). Osmotic dehydration of fruits and vegetables. *Indian Food Industry,* **12** (1) : 20-27.

Lazarides, H.N., Pedro Fito, Amparo Chiralt, Vassilis Gekas and Lenart (1999). Advances in osmotic dehydration. *Food: Quality optimization and process assessment,* LCRC Press LIC; pp. 176-191.

Lewicki, P.P. and Andrzej Lenart (1995). *Osmotic dehydration of fruits and vegetables*. Hemisphere Publication Co. New York: pp. 692-693.

Rahman, M.S. and Lamb, Jack (1990). Osmotic dehydration. *Drying Technol.*, **19**(6): 1163-1176.

Shedame, B.M. (2005). Osmotic dehydration of grapes for raisin production. M. Tech. Thesis, Dr. Panjabao Deshmukh Krishi Vidyapeeth, Akola (M.S.) INDIA.

Torreggiani, D. (1993). Osmotic dehydration in fruits and vegetable processing. *Food Res. Internat.*, **26** (1) : 59-68.