Madras Agri. J., 88(4-6) : 271 - 273 April - June 2001
https://doi.org/10.29321/MAJ.10.A00337

Physico-chemical responses of sapota packed under modified atmosphere

F. MAGDALINE ETJEEVA EMERALD[1], V.V. SREENARAYANAN[2] AND R. PARVATHY[3]

[1] *Scientist, Ginning Training Centre of CIRCOT (ICAR), Nagpur, Madhya Pradesh*
[2] *Dean, College of Agricultural Engineering, Tamil Nadu Agrl. University, Coimbatore-641 003, Tamil Nadu*
[3] *Associate professor, Dept. of Biochemistry, Tamil Nadu Agrl. University, Coimbatore-641 003, Tamil Nadu*

Abastract : Freshly harvested sapota fruits (Var. Cricket Ball) were packed in 86.35 mm (400 gauge) thick low density polyethylene bags under various modified atmospheres and stored at ambient condition (20-30°C, 66-93% RH). Changes in total soluble, sugars total soluble solids and physiological loss in weight under the influence of the treatments during storage were estimated. It was found that all treatments slowed down the process of ripening *vis* a *vis* control. Fruits packed under 2% O_2 + 10% CO_2 + 88% N_2 recorded minimum changes in physico-chemical characteristics and thus helpful in extending the shelf-life of sapota fruits by about four to five times compared to control. *(Key words : Sapota, Modified atmosphere packaging, Total sugars, Total soulble solids)*

Sapota (*Achrus sapota*) is sweet smelling and delicious tropical fruit when fully ripe. It is seasonal and highly perishable in nature. During the peak period of harvest there is a glut in the market. In order to gain considerable time to market the produce and to avoid glut, it becomes essential to extend the shelf-life of the fruits for a considerable period. Extension of shelf-life may be possible by reducing the rate of transpiration and respiration, besides checking the microbial infection. The latest technique which is gaining ground in Indian food industry is modified atmosphere packaging (MAP). To find out the optimum package atmosphere for maximising the shelf-life of sapota before disposing off, an experiment correlating the physico-chemical in the fruits and storage atmosphere was undertaken.

Materials And Methods

Freshly harvested sapota fruits (Var. Cricket Ball) with sight yellow surface colour denoting optimum maturity procured from Tamil Nadu Agricultural University orchard was used for the study. The fruits were washed in water and then immersed in 1.0 per cent potassium meta bisulphite (KMS) solution for 30 minutes to protect from fungal infection during storage. The treated fruits were shade dried to facilitate evaporation of surface moisture.

About one kilogram of surface sterilized fruits were put in 86. 35 mm thick low density polethylene (LDPE) bags having 22 x 30 cm size. They were packed under air as well as various modified combinations of O_2 CO_2 and N_2 (Table 1).

The various desired gas compositions were created by filling the bag initially with N_2 using vacuum packaging cum gas flushing machine. The quantities of O_2 and CO_2 needed for obtaining desired concentration levels inside the bag were calculated using the formula porposed by Peterson et al. (1989).

$V_d = V_t x C_p$ where,

V_d-volume of desired gas to be injected

V_t-total volume of gas

C_p-concentration on desired gas in final mixture.

A measured quantity of N_2, equal to the total calculated quantities of CO_2 and O_2 was drawn out of the bag through the silicone septum glued onto the bag surface. The calculated quantities of O_2 and CO_2 were then injected into the bag through the septum. Gas composition inside the bag was verified by employing gas chromatography.

Packed and unpacked sapota were stored at ambient condition (20-30°C, 66-93% RH) till the end of shelf-life. Unpacked sapota was kept as control. Samples were taken for analysis at an interval of seven days. The total soluble sugars was estimated by Anthrone method (Sadasivam and Manickam, 1996). The total soluble solids was determined with the help of a hand refractometer (Ranganna, 1995). For determination of physiological loss in weight (PLW), the weights of fruits were recorded prior to packing and subsequently at seven days interval. The reduction in weight was expressed in percentage basis. The storage life was estimated as the length of storage up to the time when the fruit began to show signs of decay at room temperature. The number of rotten fruits that can be marked were counted and expressed as percentage decay. All data were analysed statistically using Factorial Completely Randomised Design (FCRD) with two replications.

Results and Discussion

The total soluble sugars content of sapota fruits were analysed for all the treatments during the storage period (Table 2). Significant increase in the total soluble sugars content were noticed as the storage period increased. The initial value of total soluble sugars content was 1.98 mg 100 mg^{-1} and increased to 7.55mg 100 mg^{-1} on third day. The stored fruits were ripened after three days in the control sample (T_1). After seven days of storage, the total soluble sugars content was maximum (5.95 mg 100mg^{-1}) in T_2, followed by T_9. After fourteen days of storage, it was minimum (4.38 mg 100mg^{-1}) in T_5 and miximum (6.58 mg 100mg^{-1}) in T_{10}. The lower values of total soluble sugars indicate slow ripening of fruits. The presence of high CO_2 suppressed the ethylene production and thereby delayed the onset of the ripening process (Lau et al., 1984). Increase in sugars during storage might be due to the degradation of polysaccharides into simple sugars as reported by Naik *et al.* (1993) for tomatoes.

It is evident from the results that the total soluble solids (TSS) of sapota increased as the storage period proceeded. The mean values of different treatments on TSS of sapota were significant. It increased to 15.37 per cent after three days (T_1) from the initial value of 5.8 per cent. The TSS of sapota recorded higher level (14.16 per cent) in T_2 followed by T_9 after seven days of storage. The fruits packed under T_5 recorded the lowest level of TSS followed by T_8 after fourteen days of storage. Sapota packed under T_5 with the TSS of 9.04 per cent was found to be the best. The primary source for the increase in soluble solids content seems to be from the conversion of starch to soluble sugars during ripening. The TSS content increased in reduced O_2 and elevated CO_2 atmospheres as reported by Johnson and Ertan (1983) for apples.

Physiological loss in weight (PLW) was observed in sapota during storage in all the treatments. As the storage period increased, the PLW also increased. Statistical analysis showed that the effect of different treatments on percentage weight loss of sapota was significant. Highest weight loss was observed in control fruits after three days of storage. After seven days of storage, the higher PLW was observed in T_2 (13.84 per cent), whereas the lowest PLW (4.37 per cent) was observed in T_5. The loss of fruit weight was found to be the lowest (7.05 per cent) in T_5 after fourteen days of storage. The lower PLW under low O_2 with

Table 1. Treatment details

Treatments	Details
T_1	Control
T_2	Air packed
T_3	97% N_2 + 2% O_2 + 1% CO_2
T_4	93% N_2 + 2% O_2 + 5% CO_2
T_5	88% N_2 + 2% O_2 + 10% CO_2
T_6	95% N_2 + 4% O_2 + 1% CO_2
T_7	91% N_2 + 4% O_2 + 5% CO_2
T_8	86% N_2 + 4% O_2 + 10% CO_2
T_9	92% N_2 + 7% O_2 + 1% CO_2
T_{10}	88% N_2 + 7% O_2 + 5% CO_2
T_{11}	83% N_2 + 7% O_2 + 10% CO_2

Enriched CO_2 atmosphere might be due to the decrease in respiration rate which caused reduction in water vapour pressure difference between the furit surface and the surrounding atmosphere (Koca et al., 1993). The increase in percentage PLW during storage was reported by Ramana et al. (1984).

The shelf-life of the fruits in packages was higher than control. Shelf-life depended on the O_2 and CO_2 concentrations of the environment around the fruits. At the end of seven days of storage, sapota kept in packages remained firm while the control fruits decayed completely due to ripening within three days of storage. After seven days, sapota kept in T_2 and T_9 spoiled completely. In other treatments excepting T_5, decay ranged from 0 to 100 per cent. Sapota packed in T_5 kept well for a maximum period of fourteen days. However, storage of fruits beyond fourteen days developed off-flavour due to fungal attack. The packed fruits when removed and exposed to ambient atmosphere ripened well in a day.

The extended shelf-life of sapota in packages is attributed to the modified environment created by accumulation of CO_2 and depletion of O_2 and maintenance of high humidity inside the pack. This helped to maintain turgidity, higher firmness and freshness during storage. When the O_2 concentration is higher, the physiological and metabolic activities take place at a rapid pace inside the fruit leading to quicker spoilage.

The fully mature sapota fruits soaked in 1.0% KMS solution for 30 minutes and packed under 88% N2 + 2% O_2 + 10% CO_2 in 86.35 mm thick LDPE bags can be stored successfully up to fourteen days at ambinet temperature without much loss in fruit quality.

Table 2. Effect of different treatments on physico-chemical qualities of sapota during storage

Treatment	Total soluble surgars (mg 100 mg^{-1})		Total soluble solids (per cent)		PLW (per cent)		Decay (per cent)	
	7 days	14 days	7 days	14 days	7 days	14 days	7 days	14 days
Initial value	1.98		5.80		--		--	
T_1 Control	7.55 (3 days)		15.37 (3 days)		14.72 (3 days)		100	100
T_2 Air packed	5.95	-	14.16	-	13.84	-	0	100
T_3 97% N_2 + 2% O_2 + 1% CO_2	2.98	5.14	7.20	12.12	6.73	9.87	0	33.60
T_4 93% N_2 + 2% O_2 + 5% CO_2	2.83	4.96	7.00	11.01	4.56	7.92	0	15.85
T_5 88% N_2 + 2% O_2 + 10% CO_2	2.53	4.38	6.70	9.04	4.37	7.05	0	0
T_6 95% N_2 + 4% O_2 + 1% CO_2	3.47	5.77	7.70	13.21	5.81	10.16	0	43.70
T_7 91% N_2 + 4% O_2 + 5% CO_2	3.06	5.20	7.50	12.40	6.62	8.10	0	18.72
T_8 86% N_2 + 4% O_2 + 10% CO_2	2.64	4.51	6.80	10.52	4.44	7.63	0	11.43
T_9 92% N_2 + 7% O_2 + 1% CO_2	5.18	-	13.56	-	7.36	-	0	100
T_{10} 88% N_2 + 7% O_2 + 5% CO_2	4.77	6.58	8.40	13.98	5.93	9.71	0	22.28
T_{11} 83% N_2 + 7% O_2 + 10% CO_2	4.48	6.39	8.30	13.83	5.64	8.62	0	18.59
Cd at 5%								
Treatments	1.26		1.14		1.16		1.03	
Days	0.63		0.57		0.58		0.51	
Interaction	1.78		1.61		1.64		1.46	

References

Johnson, D.S. and Ertan, U. (1983). Interaction of temperature and oxygen level on the respiration rate and storage quality of Idared apples. *J. Hort. Sci.*, 58: 527-533.

Koca , R.W., Hellickson, M.L. and Chen, P.M. (1993). Mass transfer from 'd' Anjou pears in CA storage. Trans. of ASAE., 36: 821-826.

Lau, O.L., Y. and Yang, S.F. (1984). Influence of storage atmospheres and procedures on 1-aminocyclopropane-1-carboxylic acid concentration in relation to flesh firmness in 'Golden Delicious' apple. *Hort.Sci.*, 19 : 425-427.

Naik, D.M., Mulakhar, V.G., Chandel, C.G. and Capse, B.M. (1993). Effect of prepackaging on physico chemical changes in tomato (Lycopersicum esculentum mill) during storage. *Ind. Fd. Packer.*, 37 : 9-13.

Peterson, S.J., Lipton, W.J. and Uota, M. (1989). Methods of premixing gases in pressurised cylinders for use in controlled atmosphere experiments. *Hort. Sci.*, 24: 328-331.

Ramana, S.V., Prasad, B.A., Prasad, C.A.K. and Patwardhan, M.V. (1984). Temperature storage and the ripening behaviour of alphonso. *Ind. Fd. Packer.*, 38 : 58-64.

Ranganna, S. (1995). *Hand Book of analysis and quality control for fruit and vegetable products.* 2nd Edition. Tata McGraw Hill Publishing Co. Ltd. New Delhi.

Sadasivam, S. and Manickam, (1996). *Bichemical methods.* 2nd Edition. New Age International (P) Ltd. New Delhi.

(Received : July 2000 ; Revised : June 2001)