The Andhra Agric. J 59(3): 461-465, 2012

Effect of Modified Atmosphere Packaging on Shelf Life and Quality of Sapota

M Madhava, M Anil Reddy, Sk Haneefa Begum, Ch Rama Krishna
Department of Agricultural Engineering, College of Agricultural Engineering, Bapatla 522 101

ABSTRACT

Sapota (Achras Zapota L.) fruits ripen and may become overripe quickly. It is necessary to retard the deteriorative process to increase the shelf life of the Sapota fruits. Modified atmosphere packaging can extend the self life of perishable and semi perishable by slowing respiration. Sapota fruits are packed in PVC pouches with gas compositions of 5 % O_2, 10 % CO_2 and 85% N_2. The packed sapota fruits were kept at 10^0C, 15^0C and at room temperature.The weight loss, ascorbic acid, total soluble solids (TSS), pH of fruit samples were studied. It was observed that, the respiration of sapota fruits were very slow at 10°C followed by 15°C and room temperature. The O_2 concentration decreased and CO_2 concentration increased during the first few days of storage and reaches the steady state of equilibrium. Weight loss was about 3.1%, 4.1%, 4.3% and 16.7% at 10°C, 15°C, room temperature and unpacked fruits at room temperatures respectively at the end of the storage. The pH increases initially and decrease. Initial TSS value of sapota was 17.83 and reached maximum TSS values 23.830, 23.530, 22.890 and 22.320% brix at 10°C, 15°C, room and unpacked fruits at room temperatures respectively and then decreased. The ascorbic acid content of sapota was 17.56 mg/100g and decreased to 7.692, 7.692, 8.974 and 7.692 mg/100g at 10°C, 15°C, room temperatures and unpacked fruits at room temperature.

Key words : Quality, Modified atmosphere packaging, Sapota, Shelf life

Modified Atmosphere Packaging (MAP) is the method of "packaging of a perishable and semi perishable products in an atmosphere which has been modified so that its composition is other than that of air" (Bhande, et al. 2008). Shelf life of perishable and semi perishable products can be extended by slowing respiration, maintain appearance by slowing color development, maintain texture through slowing softening, maintain quality by slowing the growth of some micro organisms and preserve flavor by slowing use of sugars during respiration which can be done with modified atmosphere. The most commonly used films in MAP include various kinds of plastic polymers like LDPE, PVC and PP that provide protection, strength, sealability, clarity and a printable surface and should have unique function is to restrict the movement of O_2 and CO_2 through the bag and allow the establishment of the modified atmosphere.

Sapota (*Achras Zapota L.*) is one of the most commonly grown tropical fruits in the world and is known for excellent nutrition, medicinal and good source of proteins, minerals like phosphorus, calcium and iron. The total production of sapota in India accounts for 3.38 lakh tones (Kudhachikar, 2007). The sapota fruits ripen and may become overripe quickly depending upon their storage temperature and harvest maturity. Storage period of sapota depends on the respiration, relative humidity, enzymatic activity and Co_2 content of storage. In order to extend the shelf life of sapota, it is necessary to retard certain deteriorative processes. One such method to extend fresh vegetable shelf-life is the use of modified atmosphere packaging (MAP) systems. Present investigation is to study the self life and quality changes in sapota packed in PVC pouches with modified atmosphere and stored at different at temperatures.

MATERIAL AND METHODS

Raw materials

Fully matured fresh sapota fruits of local variety (Pala sapota) were procured from local market. Healthy and defects free sapota fruits were sorted out and selected for the storage studies.

Modified Atmospheric Packaging Machine

The Modified Atmospheric Packaging (MAP) machine manufactured by Reepack packaging machinery supplies, Denmark was used for packing of sapota. The machine protection by hermetically vacuum sealing the product and adding modified atmosphere. The vacuum removes the oxygen from the package. Elimination of the oxygen from package prevents oxidation and growth of micro organisms, increasing the shelf life of food products considerably.

Packaging materials

The packaging material selected was PVC pouches having a thickness of 400 gauges and size of 10X12 inch. The sapota fruits (90±10g) were packed in PVC pouches using modified atmosphere packaging machine.

Gases

The Sapota fruits were packaged in three different gas compositions of 5 % O_2, 10 % CO_2 and 85% N_2 under modified atmosphere packaging machine.

Oxygen/Carbon dioxide analyser

The Quantek model 902D is a battery-operated, portable oxygen/carbon dioxide analyser used for the measurement of O_2 and CO_2 in gas flushed MAP food packages. After packing, changes in gas composition in each pouch was determined using Oxygen/Carbon dioxide analyzer for every three days.

Storage conditions

The sapota fruits packaged under modified atmosphere in PVC pouches were kept at low temperatures of 10^0C, 15^0C and at room temperature. The unpacked sapota fruits were also kept at room temperature. For every three days, the sapota samples were taken and the changes in physical and chemical characteristics of sapota were studied.

Determination of physical and chemical characteristics

The weight loss of the sapota was measured for every three days. Initial weight of the sample after every three days the final weight was measured on electronic digital balance having an accuracy of 0.01 g.

Ascorbic acid otherwise known as vitamin C is an antiscorbutic. It is a water soluble and heat-labile vitamin. The method used is easy, rapid and a large number of samples can be analysed in a short time (*Sadasivam and Manickam, 1985*).

Total soluble solids (TSS) of fruit samples were measured (*Ranganna. 1986*) by placing a drop of the Sapota juice sample on the prism of the pocket Refractometer and expressed in terms of % brix.

The pH measurement was performed using a digital pH meter (*Ranganna, 1986*) using a glass electrode. This pH was measured for ever third day until the end of storage period.

RESULTS AND DISCUSSION

Variation in O_2 and CO_2 concentration

The variations of O_2 at different temperatures with time are shown in Fig 4.1. O_2 content is gradually decreases from 5% to 3.1% and reached a steady state concentration of 3.1% after 12 days when stored at 10°C temperature and 3.2%, 2.1% after 9 days and 6 days when stored at 15°C and at room temperatures respectively.

The variations of CO_2 at different temperatures with time are shown in Fig. 4.2. CO_2 concentration gradually increased from 10% to 20% and reached a steady state concentration of 20% after 12 days at 10°C temperature and 21%, 23% after 9 days and 6 days at 15°C and at room temperature respectively.

Therefore it was observed that the respiration of sapota fruits were very slow at 10°C followed by 15°C and at room temperature. It was also observed that the O_2 concentration in sapota packed pouches decreased and CO_2 concentration increased during the first few days of storage then it reaches the steady state of equilibrium between respiration of produce and diffusion of these gases from packing material was counter balanced by production and consumption during respiration of sapota fruits. The steady state levels of CO_2 and O_2 in these packages could cause changes in the activities of specific enzymes of the respiratory metabolism and might have uncoupling effect on oxidative phosphorylation. This might have led to the extension of shelf life of MAP packed sapota.

Variations in weight loss

The variations of weight loss at different temperatures with time are shown in Fig 4.3. It was observed that the weight losses was lower in MAP fruits stored at 10°C followed by 15°C, room conditions. Similarly weight loss was markedly lower in MAP fruits compared to unpacked fruits due to lower respiration rate of sapota fruits which would have occurred with the higher CO_2 and lower O_2 levels in the packaging covers. Weight loss was about 3.1%, 4.1%, 4.3% and 16.7% at 10°C, 15°C, room temperature and unpacked fruits at room temperatures respectively at the end of the storage

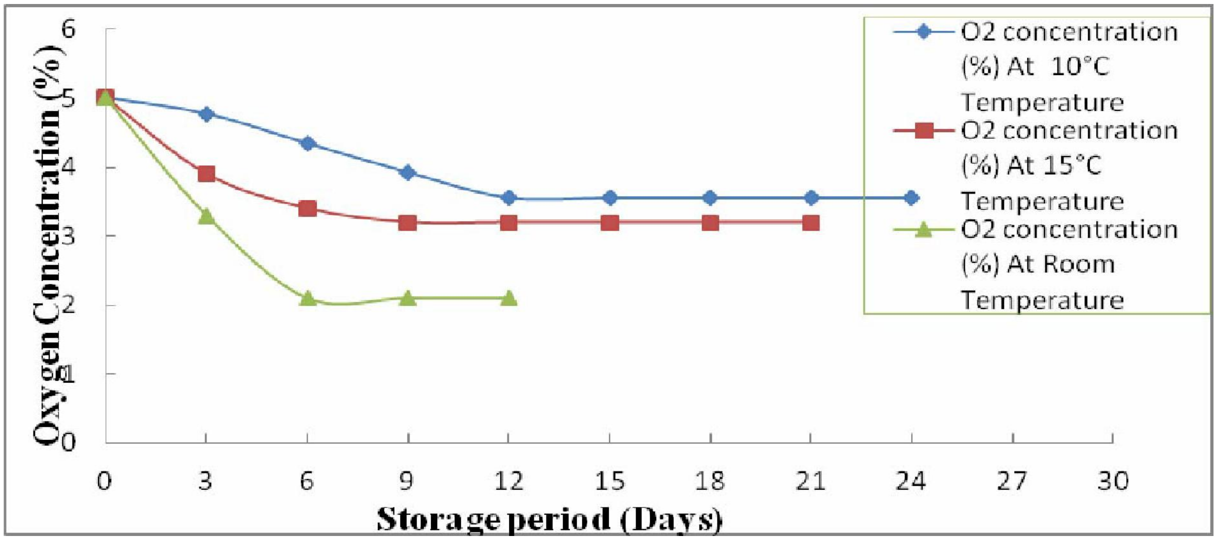

Fig. 4.1 Variation in O_2 concentration at different temperatures

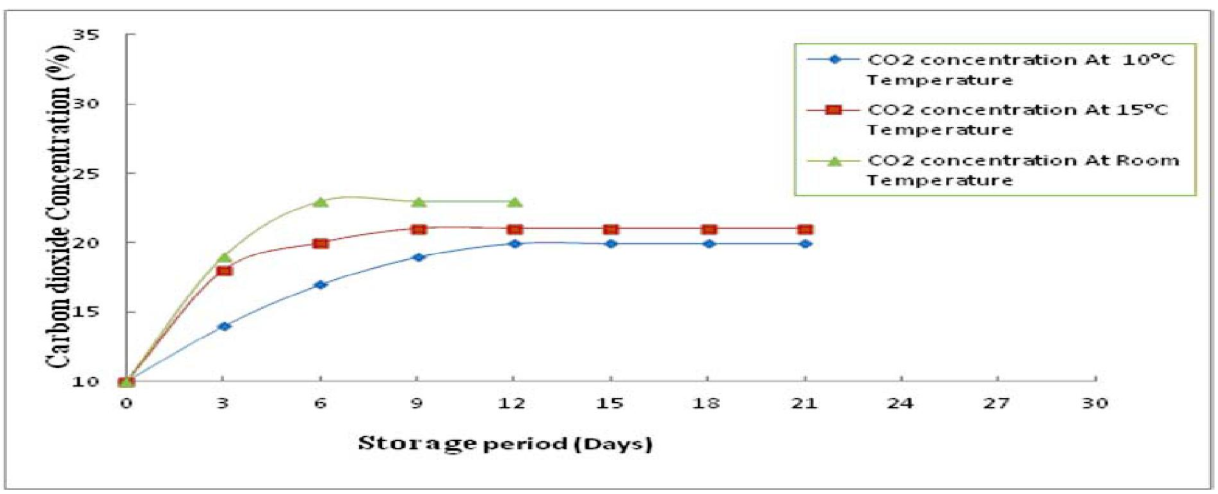

Fig. 4.2 Variation in CO_2 concentration at different temperatures

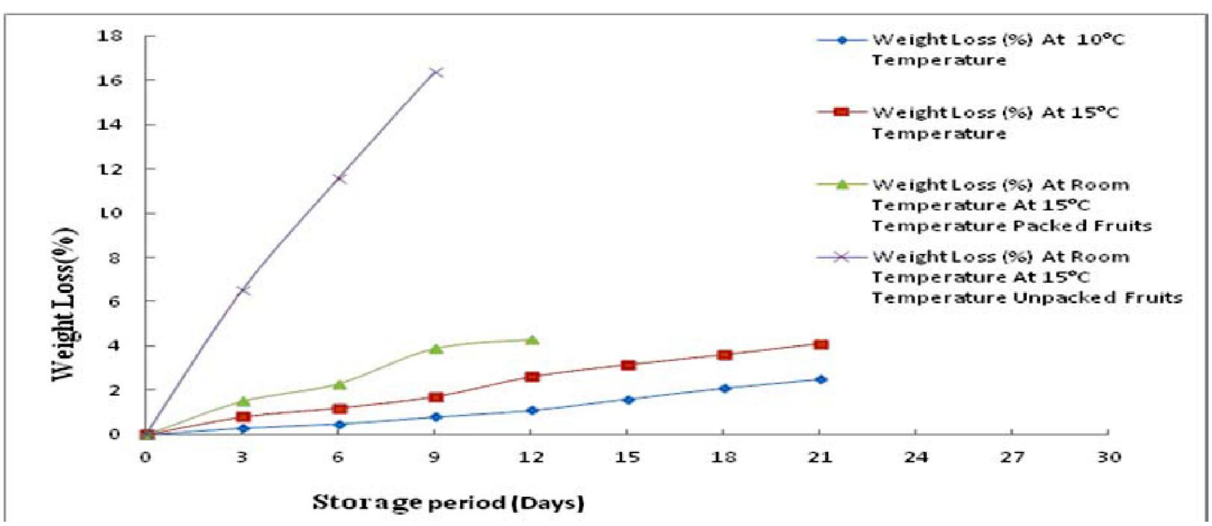

Fig. 4.3 Variation in weight loss at different conditions

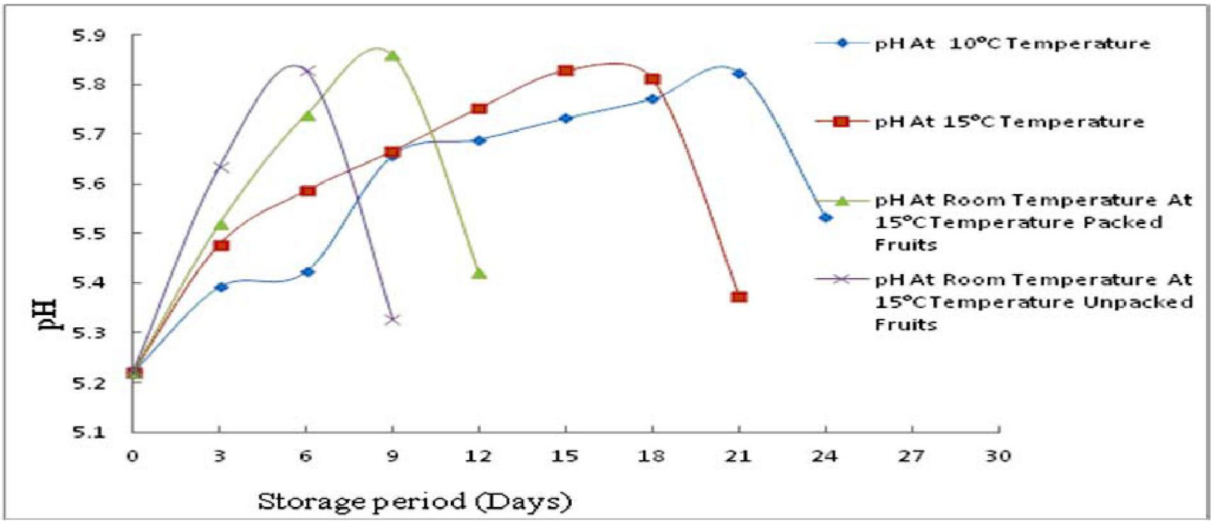

Fig. 4.4 Variation in pH at different conditions

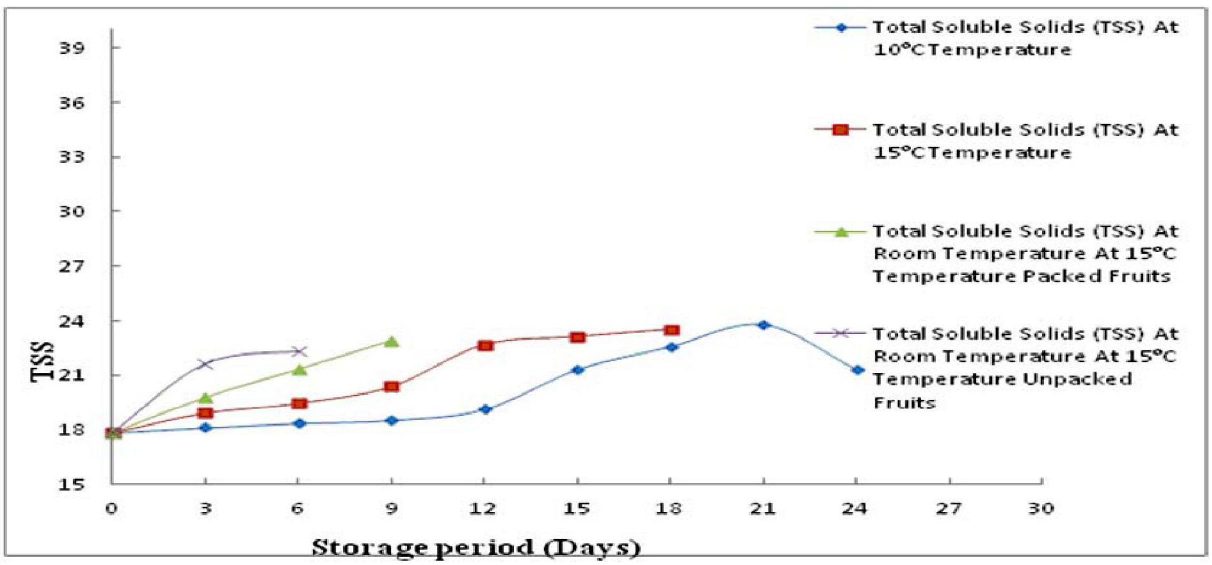

Fig. 4.5 Variation in TSS during at different storage conditions

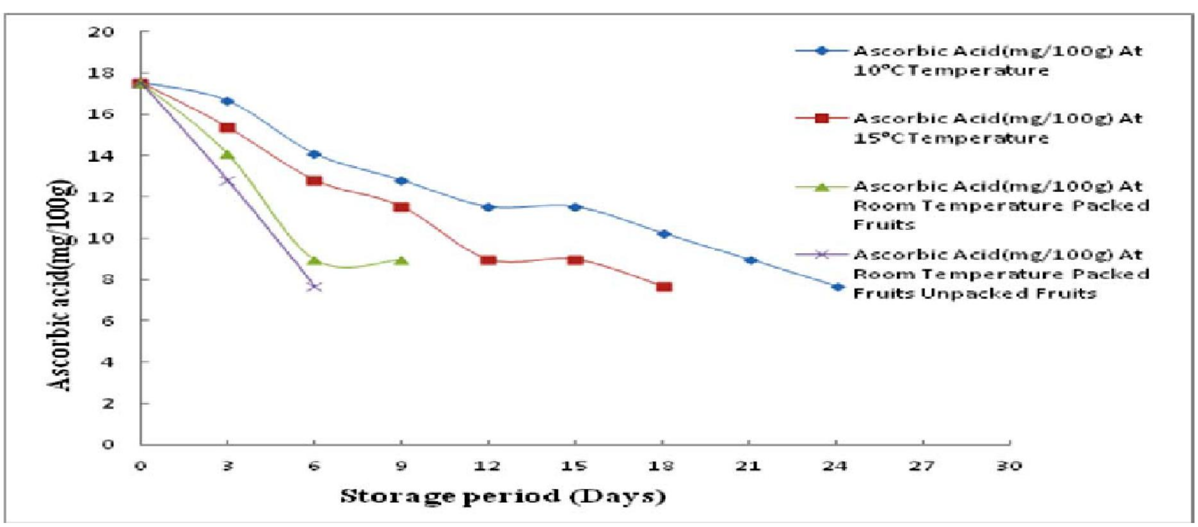

Fig. 4.6 Variation in pH during at different conditions.

period. Weight losses might be due to the retardation of the process of transpiration and respiration. A contribution may have come from the lower respiration rate of the sapotas which would have occurred with the higher CO_2 and lower O_2 levels inside the film.

Variations in pH

The variations of pH at different temperatures with time are shown in Fig. 4.4. The pH value is lower at 10°C followed by 15°C and room temperatures. During storage period, pH values gradually increases from the initial values and then decreases at a particular time which refers to the optimum storage duration of the sapota. The increase in pH values is due to conversion of sugars into the acids by fermentation process of sugars and the decrease in pH values is due to turning sour from fermentation of sugars. The maximum pH values observed are 5.824, 5.827, 5.859 and 5.827 at 10°C, 15°C, room temperature and unpacked fruits at room temperature on 21, 15, 9 and 6 days respectively, which represents the shelf life of sapota fruits.

This could be due to higher rates of respiration and biochemical deterioration at relatively higher storage temperature. Increased pH (decreased acidity) in MAP packed sapotas following exposure to elevated CO_2 was observed. This could be due to consequence of high CO_2 concentration effects on normal metabolism of packed fruits

Variations in total soluble solids

The variations of TSS at different temperatures with time are shown in Fig. 4.5. The initial TSS value of sapot was 17.83% brix and the maximum TSS values observed was 23.830, 23.530, 22.890 and 22.320% brix at 10°C, 15°C, room and unpacked fruits at room temperatures after 21,18, 9 and 6 days respectively. The increase in TSS during storage was due to the breakdown of complex polymers into simple substances by hydrolytic enzymes and decrease in TSS was due to its utilization in respiration process. The TSS were highest in fruits stored at room temperature without packing followed by packed fruits at room temperature , 15°C, 10°C temperature. The increase in soluble solids relates to fruit ripening and the decrease in soluble solids indicates that the utilization of the soluble solids for respiration exceeds production.

Variations in ascorbic acid

The initial ascorbic acid content in fresh sapota was 17.56 mg/100g and the final ascorbic acid content in fruits stored at 10°C, 15°C, room temperatures and unpacked fruits at room temperatures were 7.692, 7.692, 8.974 and 7.692 mg/100g on the last day of storage period respectively. The variations of ascorbic acid at different temperatures with time are shown in Fig. 4.6. Ascorbic acid is significantly decreased with time and temperature of storage due to high CO_2 concentration which retards the change in ascorbic acid and also due to degradation of ascorbic acid molecules forming dehydro ascorbic acid by enzymes.

Conclusions:

The shelf life of the Sapota fruits can be increased upto about 21 days by packing under modified atmosphere conditions and storing at 10°C temperature. Less weight loss and TSS values and higher ascorbic acid values were observed at lower temperature. The O_2 concentration depletes and reaches steady state equilibrium while CO_2 concentration increases and reaches steady state equilibrium.

LITERATURE CITED

Bhande S D Ravindra M R and Goswami T K 2008 Respiration rate of banana fruit under aerobic conditions at different storage temperatures. *Journal of Food Engineering,* 87: 116-123.

Kudachikar V B Kulkarni S G Vasantha M S Aravinda Prasad B and Aradhya S M 2007 Effects of modified atmosphere packaging on shelf life and fruit quality of banana stored at low temperature. *Journal of Food Science and Technology*, 44(1): 74-78.

Ranganna S 1986 Handbook analysis and quality control for fruit and vegetable products. Tata McGraew-Hill, New Delhi: 872-879.

Sadasivam S and Manickam A 1985 Determination of lycopene content and ascorbic acid in tomatoes. Biochemical methods by publisher new age international, NewDelhi: 184-190.

(Received on 14.11.2011 and revised on 02.02.2012)