INNOVATIVE TECHNIQUES FOR THE SHELF-LIFE EXTENSION OF EGGPLANTS

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ABSTRACT

Eggplant fruits (garden eggs) harvested two weeks after fruit set were grouped into four batches (two with intact stalks - LST and BST; and the other two with the stalks removed - LNS and BNS) and stored for 14 days in two packages - raffia woven baskets and perforated LDPE bags. Moisture content, Weight loss, Total Soluble Solids, degree of shrivelling and Sensory Analysis were significantly different from that of BST ($P < 0.05$) on day 14. Total soluble solids content of LNS and BNS were lower than BST and LST on day 14. Degree of shriveling of BST was significantly different from LST, LNS and BNS ($P < 0.05$). The degree of "liking" for LNS BNS and LST BNS and LST by 20 trained panelists was not significantly different from that of a fresh sample ($P < 0.05$).

1.0 INTRODUCTION

Recent developments in agricultural technology have substantially increased world food production in the last three decades (Salunkhe et al., 1991), however poor handling and inadequate storage facilities as well as the lack of appropriate storage techniques to suit every type of food. Post harvest losses is extremely rife in the fruits and vegetables production sector. These losses have been estimated to be more than 40 to 50 percent in the tropics and subtropics (Salunkhe et al., 1991; Kader et al., 1985; Wills et al., 1982). Sobotie et al. (1992) estimated that in Ghana the percent loss for garden egg fruits is above 50 percent during the rainy season.

Recently, consumers have shown a willingness to pay more for foods that are perceived as fresher, of high quality or greater value. Meeting this demand while maintaining adequate distribution time has necessitated new technologies designed to extend shelf life without sacrificing quality(Hotchkiss, 1988). In the case of the garden egg several workers have tried to extend storage life using refrigeration (Esteban et al., 1989; Nakamura et al., 1986; Rhee and Iwata, 1982; Abe et al., 1980; Kozukue et al, 1979; Abe and Ogata, 1978; Kozukue et al., 1978; Tataru and Hristea, 1977) yet they all reported that the eggplant is susceptible to chilling injury at temperatures below 10°C. Some have recommended 15° C as the minimum temperature for the storage of eggplant fruits.

More recently there has been a renewal of interest in the use of Modified Atmosphere Packaging (MAP) for the shelf life extension of foodstuffs (Smith et al., 1982). Eggplants wrapped in perforated polyethylene films and in tissue have extended shelf life compared to storage in sealed plastics, which significantly increases decay (Risse and Miller, 1983; Uncini et al., 1976). Other workers have used films of food grade was to extend the shelf life of eggplants (Kader et al., 1985). However, most of these methods have some demerits (Wardlaw, 1933; Chase and Pantastico, 1975).

The garden egg (eggplant) is an indispensable part of the human diet in Ghana but is usually in short supply during the dry season. The fruit (used mainly as a vegetable) grown abundantly during the rainy season is wasted because no modern preservation method exists that is economically feasible and easily adoptable. Thus during periods of market glut there is a marked reduction in prices such that farmers are found grumbling incessantly (Kllis et al., 1994; Sobotie et al., 1992).

The post harvest losses of garden egg fruits in Ghana is exacerbated by the topical weather. Farmers and retailers are always faced with the problem of rapid loss of moisture resulting in shriveling and ripening three days after harvesting. At optimum storage temperatures of 45°F and 90% relative humidity (RH) garden eggs cannot be stored for more than a week and still retain good conditions for retaining (Norman, 1974).

The objective of this work was to develop a technique that will extend the shelf life of garden eggs beyond the period of 7 days without loss in overall consumer acceptance characteristics, and easily adoptable by the Ghanaian community.

2.0 MATERIALS AND METHODS

2.1 Source of garden eggs

Garden egg fruits cv. Improved Fanti, obtained from the commercial farm of an Agricultural Extension Officer at Bekwai were used for this study.

2.2 Experimental Design and Statistical Analysis

For this study a randomized complete block design (RCBD) involving four factors, namely, stalk removal, intact stalks, basket package and low density polyethylene package (LDPE). All determinations were done in triplicate. Statistical analysis (ANOVA) was carried out on the results obtained (Gacula and Singh, 1984).

2.3 Sample Preparation

Samples of the improved "Fanti" cultivar was harvested at the developmental stage of two weeks after fruit set when fruits are considered to be of commercial maturity in Ghana. The samples were grouped into two batches, those with the stalks (calyx) intact (ST) and those with the stalks removed (NS). Each batch was further grouped into two batches of 50 fruits/batch. One set was packaged only in raffia woven baskets as primary packages - BST, BNS; and the other set packaged in perforated low density polyethylene bags as primary packages - LST and LNS. All four treatments (LST, LNS, BST and BNS) were kept in the shade and monitored over a 14 days period.

2.4 Moisture determination

2g of each sample, chopped up with a Waring blender (Model 36BL23) was weighed into previously weighed crucibles and maintained for 16 hours in an oven (Gallenkamp Model D35, MIDO/3/ss/F) at 105°C. Moisture was expressed as percent per fresh weight.

2.5 Weight Loss determination

The weights of the sample were initially determined, and at selected periods samples were randomly selected and their weights determined using the top loading balance (Gallenkamp, Mettler P1200 Model). This was done throughout the experimental period. Weight losses were expressed as percent per fresh weight.

2.6 Total Soluble Solids (TTS)

Pressed juice from selected samples of each treatment was used in determining the TSS using an Abbe Refractometer (Carl Zeiss, Jena, Model G) at specific temperatures and corrected to 20°C A.O.A.C., 1984). Values were expressed in °Brix.

2.7 Colour determination

Selected garden egg fruits from each treatment were monitored during the course of the experimental period for surface colour change using a Minolta Chroma Meter CR-200. Tristimulus CIE (1976) colour readings (L^* a^* b^*) were determined and was taken as an average of eight different points on the circumference using a standard calibration tile ($L^* = 69.1$, $a^* = 23.4$ and $b^* = 9.3$) (Yang and Chinnan, 1987; Hyun et al., 1994).

2.8 Sensory Evaluation

Two sensory tests were conducted on the samples on the fourteenth day after storage. A Descriptive test involving 10 trained panelists was done to determine the degree of shrivelling on a 15 cm unstructured line scale with anchor points at 1.5 cm (Resurreccion and Shewfelt, 1985; Park et al ., 1994). An Affective test was also done involving 20 trained panelists who assessed 4 differently treated samples using the hedonic scale in order of "liking". One of the four samples was a fresh sample obtained from the farm just before the analysis which served as the control.

3.0 RESULTS

The trend in moisture content of the four treatments is shown in Figure 1. Generally there was a decrease in moisture content with time (day) for all the four treatments. The highest loss in moisture was observed with BST and the lowest in LNS. The basket packaged samples had a higher loss in moisture compared to the LDPE packaging sample and was highly significant ($P < 0.05$). For each packaging material the unstalked samples (no calyx) had significantly lower moisture loss ($P < 0.05$ than the stalked (with calyx) samples after day 10.

Figure 2 shows the weight losses recorded for each treatment. The trend correlates well with the moisture correlates well with the moisture loss observed for each sample in that the observed in the LNS treatment. Generally, significant differences existed between the basket packaged samples and the LDPE samples ($P < 0.05$). Again the unstalked samples had lower weight losses than the stalked one with time (days).

Figure 3 shows the trend observed in the TSS content of the four treatments with time (days). There was generally a decrease in the TSS content for all the treatments. The lowest TSS content was observed in LNS and the highest in BST and LST on day 14. Thus the unstalked samples had lower TSS on day 14 than the stalked.

Figure 4 (a, b. and c) are the graphs for the changes in the four descriptors of colour; Value (L*), Hue (a*) and Chroma (b*) respectively for all the treatments. The L* values decreased (became darker) with time (days) for all the treatments in the order: LNS < BNS < LST < BST. Thus darkening of the colour was higher in the stalked (with calyx) samples than the unstalked samples and on day 14 there was a significant difference ($P < 0.05$) between the stalked and unstalked samples. The hue angle (a*) increased from a negative value (white) to positive values (red) for all the treatments. BST had the highest value on day 14 with LNS having the least value on day 14 than the unstalked samples and significant differences ($P < 0.05$) existed between them. Chroma (b*) results for all the treatments increased with time (days. The stalked samples had higher values (more vivid) in colour than the unstalked sample.

In the descriptive test panelists described BST as the "most shriveled" followed by BNS. No shriveling was recorded for samples stored in LDPE bags (LNS and LST). All panelists observed "very little shriveling" in the BNS sample, and a significant difference ($P < 0.05$) was observed between BST and the other 3 treatments on day 14. In the affective test there was no significant difference ($P < 0.05$) in terms of the degree of "liking" for a fresh sample, BNS, LNS and LST.

4.0 DISCUSSION

One would be inclined to think that the unstalked sample (LNS and BNS) would have a reduced shelf life because of the injury created after removal of the stalk. The overall results, however, showed an extended shelf life for the unstalked samples. This may be attributed to the significantly reduced weight and moisture loss as shown in Figures 1 and 2. According to Wills et al (1981) a weight loss of 5% will cause perishable commodities to appear wilted and shriveled. This thus affects saleable weight and is a direct loss in marketing. Mechanical damage can greatly accelerate the rate of water loss from produce. Bruising damages surface organization of the damaged area (Wills et al., 1981).

The response of plant organs to stress such as bruising and mechanical damage may be accompanied by wound healing, that is, the formation of a physical barrier of protective substances; or the sealing off of the affected area with a layer of corky callus cells (Wills et al., 1981; Haard, 1985). This is important in certain commodities since these barriers can have a profound influence on preventing the invasion by saprophytic microorganisms, influx of excessive oxygen and subsequent spoilage. The scar tissue thus serves to prevent the further loss of water through the damaged end. So in this work the scar tissue formed from the wound healing reduced the moisture loss, weight loss and hence shriveling. This brings to the fore the fact that eggplants lose a greater quantity of water through the lenticels on the stalk. This observation was also made in similar curing methods by Grierson and Wadowski (1978).

With the scar tissue reducing moisture loss and regulating gaseous exchange the use of perforated low density polyethylene bags further reduced moisture loss and hence weight loss since a modified atmosphere
may have been created in the bags which slowed down metabolic activity and gaseous exchange around the fruits. The lower TSS content of the LDPE packaged fruits may be attributed to the formation of ethanol through fermentation processes since the oxygen that might have been available to the fruits may have also been so low as to trigger off anaerobiosis.

The reduced ripening rate of the LDPE packaged fruits and the unstalked fruits packaged in baskets may be attributed to lower metabolic activity due to the low oxygen available to the fruits after wound healing.

5.0 CONCLUSION

Stalk removal and storage of eggplant fruits in perforated LDPE bags serve as a very effective means of extending shelf life of the produce. Use could be made of this technique in the shelf life extension of the eggplant fruits, an indispensable vegetable in the diets of most West Africans.

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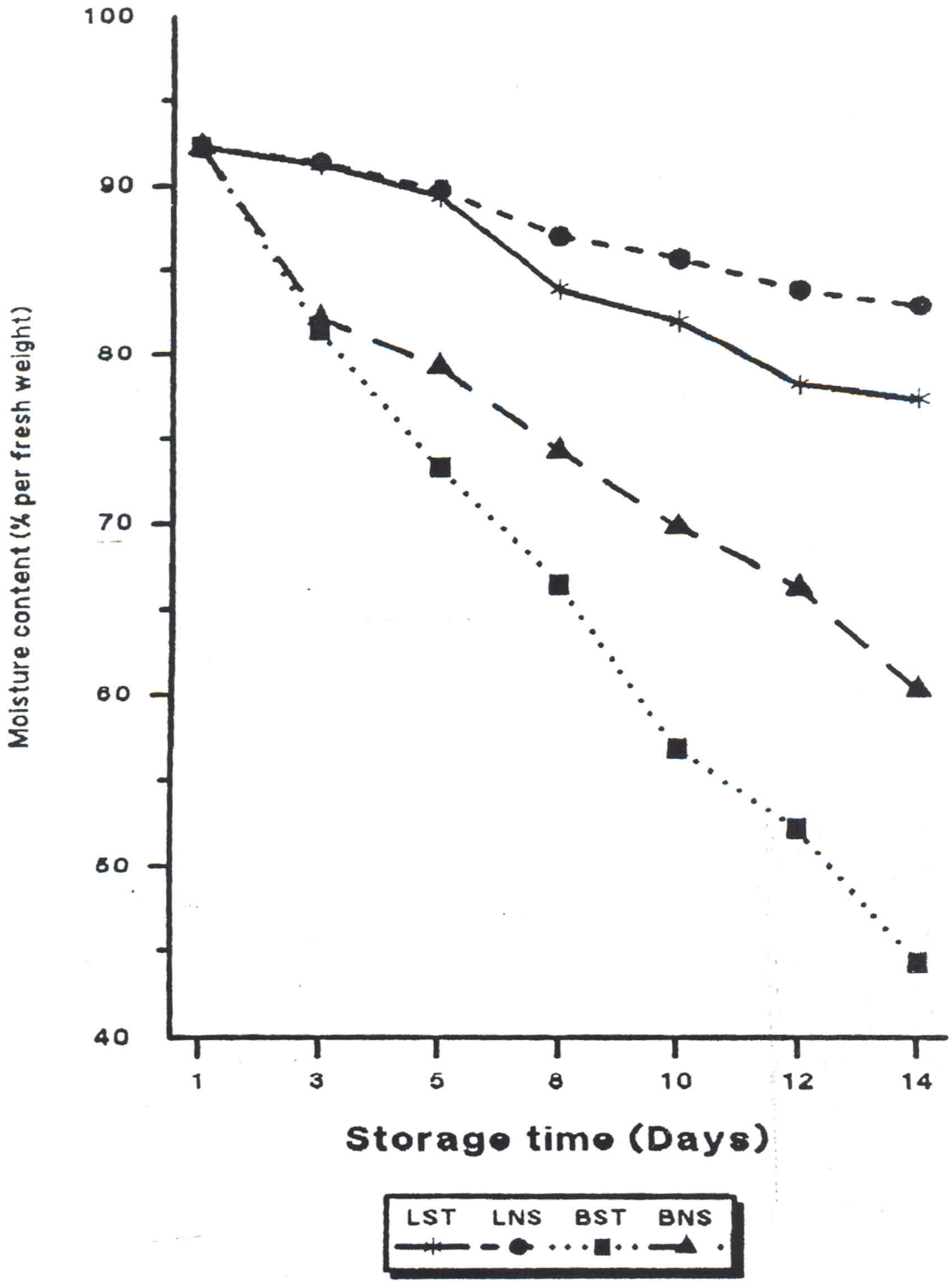

FIGURE 1: Moisture content of garden eggs fruits cv. Improved Fanti with Time (days)

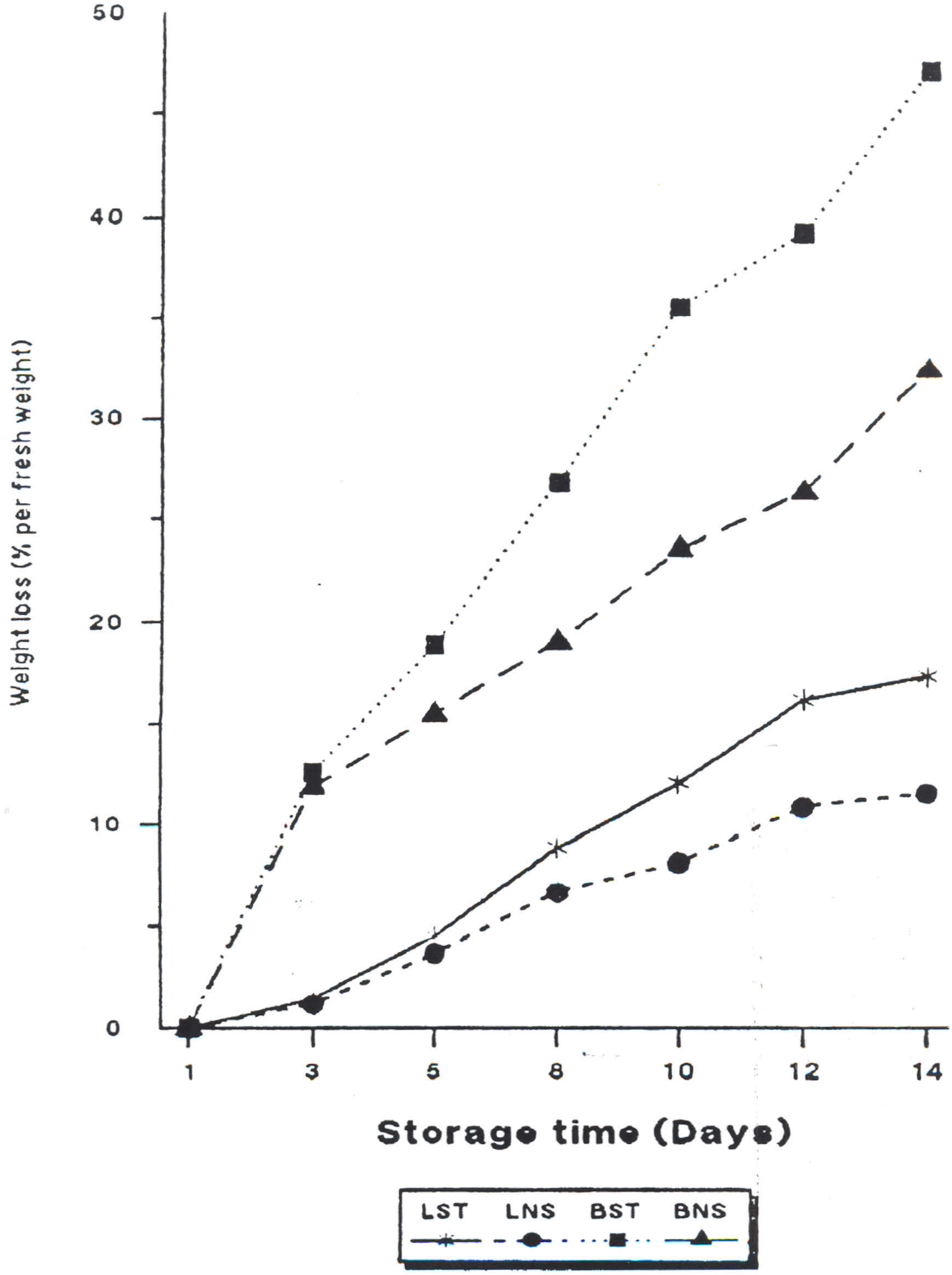

FIGURE 2: Weight losses in garden egg fruits cv. Improved Fanti with time (days)

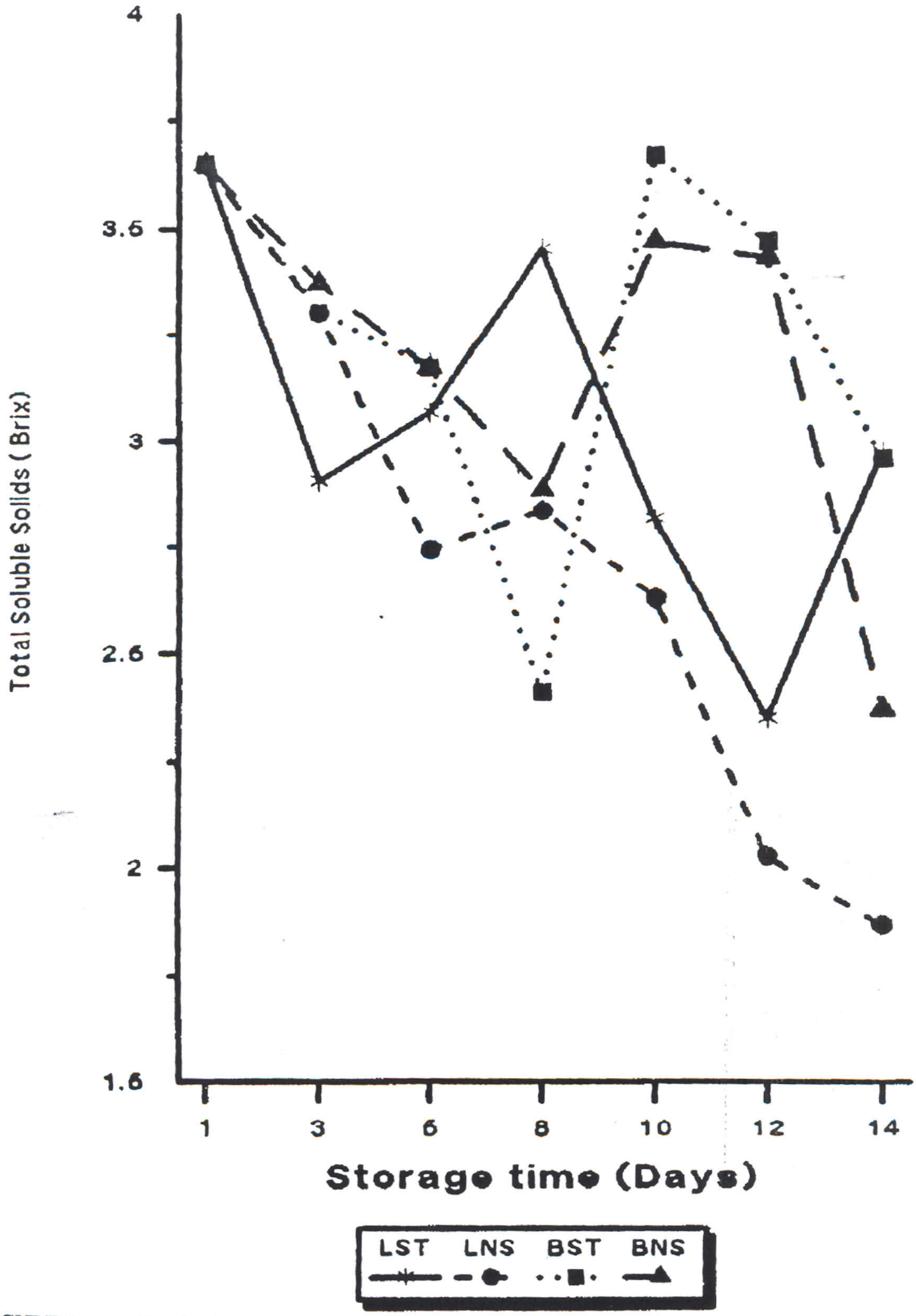

FIGURE 3: Total soluble solids content of garden eggs fruits cv. Improved Fanti with time (days)

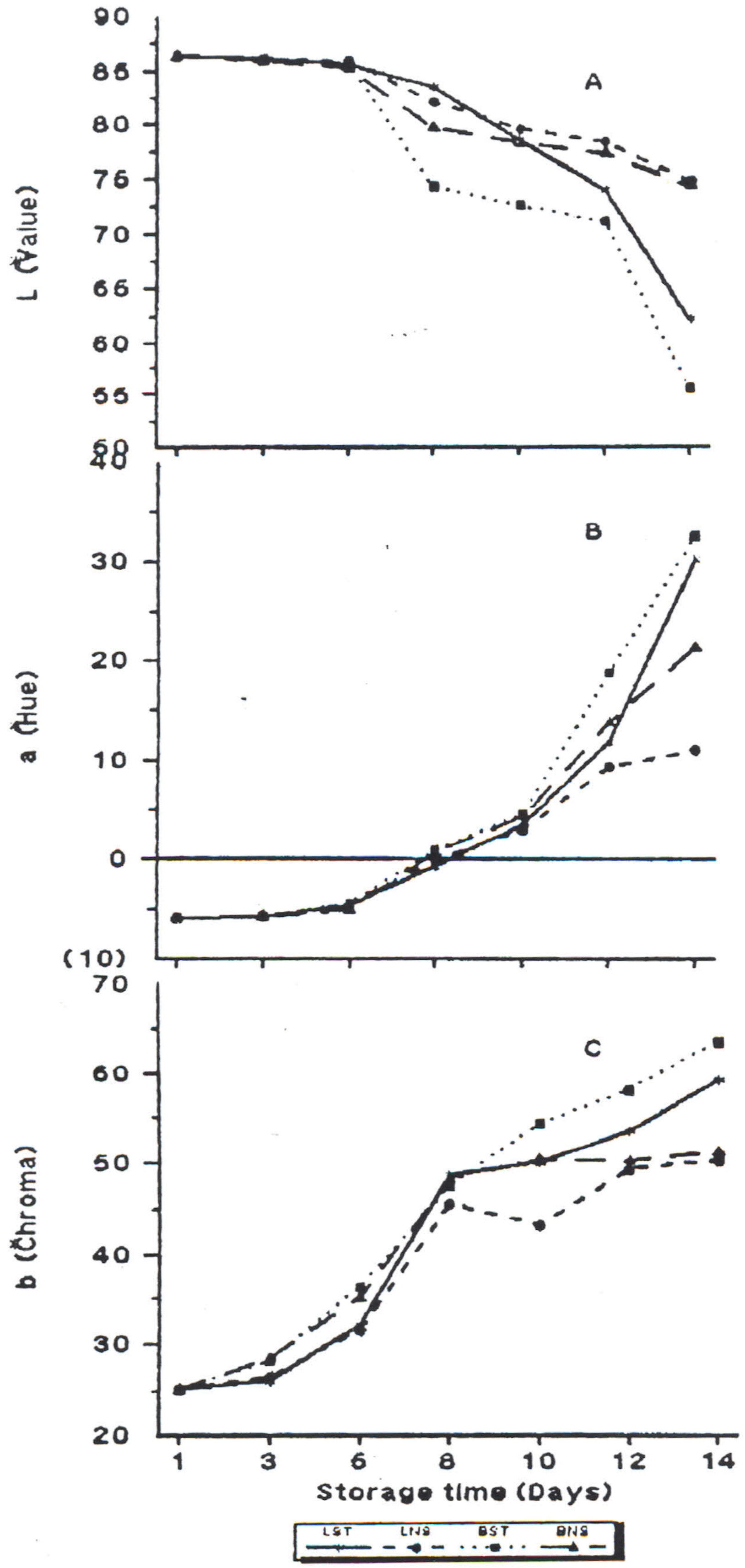

FIGURE 4: Colour change of samples with time (days)