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Effect of different packaging and storage conditions on shelf-life of processed drumstick leaves

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ABSTRACT : Green leafy vegetables are common in the Indian diet. A variety of greens are consumed in different parts of the country. Leafy vegetables are highly perishable and their shelf life depends on duration and conditions of storage. In the view of the increasing demand for products with a fresh-like quality which are very nutritious and easily available in the local market, a research has been conducted to assess the quality of the drumstick leaves by using different packaging materials and methods under different storage conditions. Influence of packaging conditions on minimally processed drumstick leaves were studied during 12 days of storage at 5^0C. The pretreated drumstick leaves were packaged in Low density polyethylene (LDPE) and polypropylene materials of different thickness namely, 150, 250 and 350 gauges under normal ambient air and refrigerated condition and stored in ambient (25 ± 2^0 C), refrigerated (5 ± 2^0 C) temperatures with quality analysis under a day interval for twelve days. The results observed for different conditions with respect to the quality deterioration revealed that 350 gauge thick LDPE was found to be the best in maintaining the colour and the reduction in vitamin C content(150 mg/ 100 g), beta carotene content (4793 µg/100 g) was found to be less during the storage and it was also observed that the rate of increase in the microbial load *i.e.* fungi, bacteria was less with the values 2.96 x10^6 and 1.21 x10^4, respectively at the end of storage period

KEY WORDS : Packaging, Storage, Conditions, Shelf-life, Drumstick leaves

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Green leafy vegetables are fair source of pro vitamin A (carotene), ascorbic acid and potassium. These serve as a good source of water-soluble vitamins such as thiamin, riboflavin, nicotinic acid as well as minerals, calcium, phosphorus and iron. Green leafy vegetables are less expensive and easily available sources of micro nutrients. India is the second largest producer of green leaves next to China with an estimated production of 96 million tonnes. Drumstick tree *(Moringa oleifera)* is grown mainly in semi-arid, tropical and subtropical areas. It is considered as one of the most useful trees, as almost every part of the moringa tree is used for food or has some other beneficial property. India is the largest producer of moringa, with an annual production of 1.1 to 1.3 million tonnes of tender fruits from an area of 38000 ha. The leaves are highly nutritious, being a significant source of beta-carotene, vitamin C, protein, iron and potassium. Minimal processing gives additional value in terms of convenience and time saving. The minimally processed vegetables that are packaged in low density poly ethylene (LDPE) and poly propylene films which have thickness between 25 and 100 µm prevent weight loss by maintaining high humidity and prevention of moisture loss (Ati and Hotchkiss, 2002). Subadra *et al.* (1997) determined the retention and storage stability of beta-carotene in dehydrated drumstick leaves and the results have revealed that, the sulphiting in addition to blanching was more effective in the retention of beta-carotene immediately after dehydration Consumers always show inclination towards fresh green leafy vegetables, than their processed ones. There is also demand for this fresh product when available in a convenient and fully edible form. It is here that the concept of minimal processing has emerged to satisfy the demand of high quality products in terms of nutrients, cost efficiency and less energy utilization. Minimally processed product usually describes a fresh product in a conveniently peeled, cored or sliced form which is fully edible. In the view of above problems a research has been conducted to study the effect of different packaging materials on shelf life of minimally processed drumstick leaves under different storage condition for specified period of time and the results were observed and

analyzed for better packaging and storage period.

METHODOLOGY

Drumstick leaves were procured from the local market and in that the fresh green leafy vegetables were selected for further processing. The packaging materials were procured from nearby areas and the selection of the materials was based on the availability, cost and strength, which are the basic parameters during the selection of any packaging material. The packaging materials and methods in terms of treatments were given in Table A.

Table A : Experimental treatments for drumstick leaves

Sr. No.	Details	Treatments
1.	Control	T_1
2.	Air packaged in 150 gauge (PP)	T_2
3.	Air packaged in 250 gauge (PP)	T_3
4.	Air packaged in 350 gauge (PP)	T_4
5.	Air packaged in 150 gauge (PE)	T_5
6.	Air packaged in 250 gauge (PE)	T_6
7.	Air packaged in 350 gauge (PE)	T_7

PP – Poly Propelene, PE – Poly Ethylene, T – Treatments

Uniformly matured drumstick leaves were selected for processing. The most quality loss in leaves results from either formation of white blush, off-odours and slimy surface generated by bacteria. Leaves were carefully handled. Damaged stem were removed before processing. The separated leaves were pretreated with chlorinated water having the concentration of 150 ppm for 1 minute. The pretreated leaves were air dried for 10 minutes for complete removal of moisture from the surface of the produce. The air dried leaves were packaged in polypropylene and polyethylene bags and all the test samples were stored at the temperature of 5°C and the flow chart is given in Fig. 1.

After packaging in different the leaves were kept under two different atmosphere namely ambient atmospheric condition and refrigerated condition for storage studies with the quality analysis under alternate day intervals. The quality parameters were colour, ascorbic acid, beta carotene, bacteria, fungi and the procedure to assess the quality is as follows:

Colour :

The change in the colour (ΔE) was observed using a Hunter Lab Colourimeter and the values of L, a, b were used to measure the colour change and the microbial load was analyzed using the plate count method.

Ascorbic acid :

Ascorbic acid also known as vitamin C, an antiscorbutic component which determines the quality of the product. Ascorbic acid was determined by dye method (Sadasivam and Manickam, 1992). Quantity of ascorbic acid (mg) present in 100 g of sample was calculated as:

$$\text{Ascorbic acid } \left(\frac{\text{mg}}{\text{100g}}\right) = \frac{0.5}{V_1} \times \frac{V_2}{5\text{ ml}} \times \frac{50\text{ ml}}{\text{weight of the sample}} \times 100$$

Beta carotene :

Beta carotene content present in the drumstick leaves was analysed by following acetone-petroleum ether extract method and quantity of beta carotene (µg) present in 100 g of the sample was calculated as given below:

$$\text{Beta carotene} = \frac{\text{Absorbace at 453 nm}}{0.2592} \times \frac{\text{Total valume}}{\text{weight of the sample}} \times 100$$

Microbial load :

The shelf life and microbial quality of drumstick leaves is based on number and kind of microorganism present in it, which was assessed by serial dilution and plating method for enumeration of bacteria and fungi, respectively (Martin, 1950).

Statistical analysis :

Statistical analys was as carried out to study the effect of different parameters on all the dependent variables. Analysis of variance (ANOVA) was conducted with Completely Randomized Block Design (CRBD) using the AGRES software.

RESULTS AND DISCUSSION

The present study has been taken up with the objectives of minimal processing drumstick leaves packaging in different thickness of polypropylene and polyethylene bags in different storage condition. The investigation included study of various pretreatments and storage life of drumstick leaves under different storage conditions. The physico-chemical properties and microbiological characteristics with reference to storage period and of minimal processing drumstick leaves are presented and discussed in this chapter. During storage different quality parameters like colour, ascorbic acid, beta carotene and microbial load were determined at each interval of the day.

Colour :

'L' value :

The initial 'L' value of fresh drumstick leaves was recorded as 46.77. The 'L' value showed a gradual decrease with increase in storage period. From the Fig.1. it can be seen that rate of decrease was minimum for drumstick leaves packaged in T_4, T_6 and T_7 than T_2, T_3 and T_5 and control (T_1). Comparing the effect of thickness of packaging material, 350 gauge thick polyethylene (T_7) was found to be the best in reducing the rate of decrease of 'L' value. The 'L' value on 12th day of storage for T_4, T_6 and T_7 were 43.68, 44.22 and 44.05, respectively.

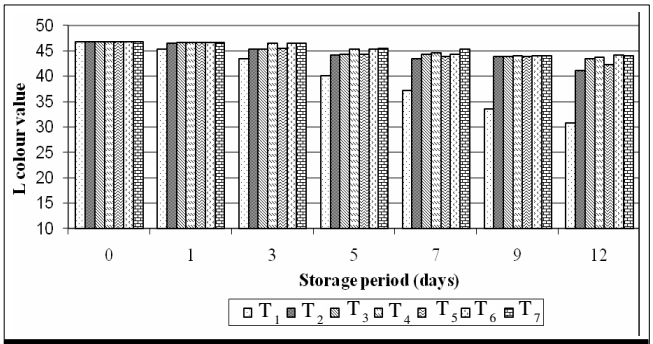

Fig. 1: Effect of different treatments on 'L' value of drumstick leaves during storage

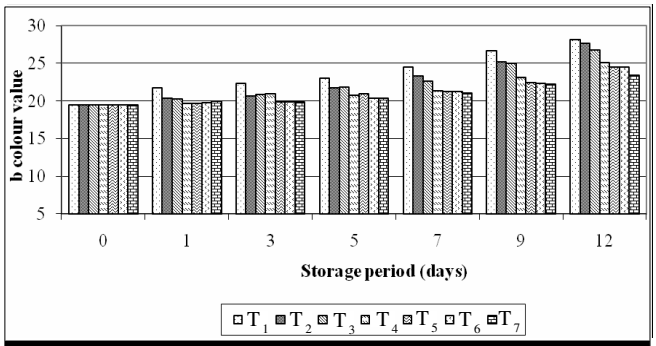

Fig. 3: Effect of different treatments on 'b' value of drumstick leaves during storage

'a' value :

The initial 'a' value of fresh drumstick leaves was recorded as -9.28. From the Fig. 2, it was revealed that 'a' value decreased with increase in storage period. And rate of decrease was minimum for drumstick leaves packaged in T_4, T_6 and T_7 than T_2, T_3 and T_5 and control (T_1). Comparing the effect of thickness of packaging material, 350 gauge thick polyethylene (T_7) was found to be the best in reducing the rate of decrease of 'a' value. The 'a' value on 12th day of storage for T_4, T_6 and T_7 were -6.80, -7.19 and -7.48, respectively.

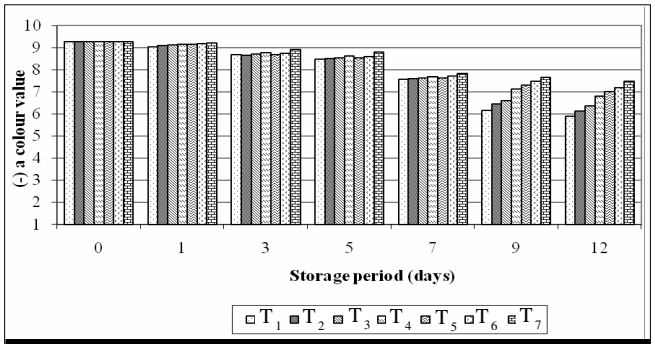

Fig. 2: Effect of different treatments on 'a' value of drumstick leaves during storage

'b' value:

The initial 'b' value of fresh drumstick leaves was recorded as 19.45. From the Fig. 3, it was revealed that 'b' value increased with increase in storage period and rate of increase was minimum for drumstick leaves packaged in T_4, T_6 and T_7 than T_2, T_3 and T_5 and control (T_1). Comparing the effect of thickness of packaging material, 350 gauge thick polyethylene (T_7) was found to be the best in reducing the rate of decrease of 'b' value. The 'b' value on 12th day of storage for T_4, T_6 and T_7 were 25.06, 24.48 and 23.37, respectively.

Ascorbic acid :

The initial ascorbic acid of fresh drumstick leaves was recorded as 200 mg/100 g. From the Fig. 4, it can be observed that vitamin C content decreased with increased storage period. The rate of decrease was less in drumstick packaged in T_7, T_6 and T_4 than T_2, T_3 and T_5 and control (T_1). Comparing the effect of thickness of packaging material, 350 gauge thick polyethylene (T_7) was found to be the best in reducing the rate of decrease of vitamin C content. The ascorbic acid value on 12th day of storage for T_4, T_6 and T_7 were 162 mg/100 g, 165 mg/100 g and 172 mg/100 g, respectively.

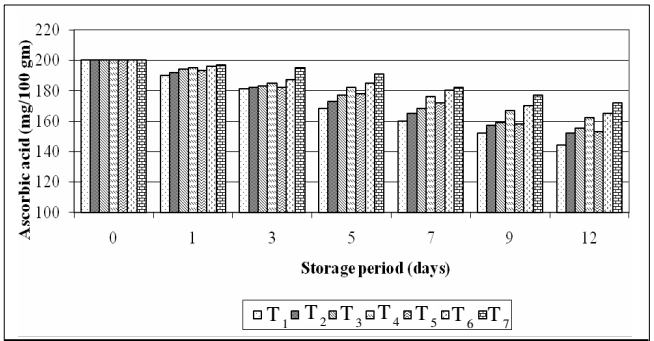

Fig. 4 : Effect of different treatments on ascorbic acid of drumstick leaves during storage

Beta carotene :

The initial beta carotene value of fresh drumstick leaves was recorded as 6840 µg/100 g. From the Fig. 5, it can be observed that vitamin A content decreased with increased storage period. The rate of decrease was less in drumstick packaged in T_7, T_6 and T_4 than T_2, T_3 and T_5 and control (T_1). Comparing the effect of thickness of packaging material, 350 gauge thick polyethylene (T_7) was found to be the best in reducing the rate of decrease of beta carotene value. The beta carotene value on 12th day of storage for T_4, T_6 and T_7 were 5760 µg/100 g, 5810 µg/100 g and 6140 µg/100 g, respectively.

Bacterial load :

From the Fig. 6 it was observed that bacterial population

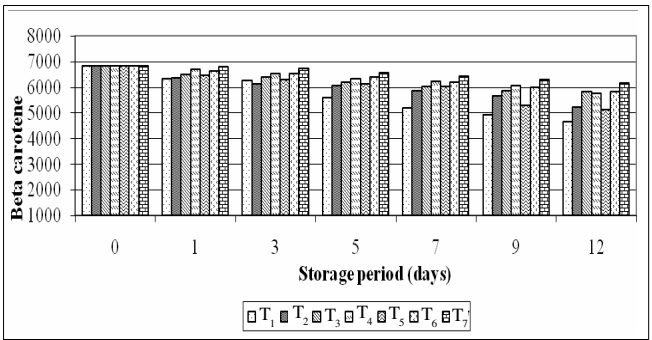

Fig.5: Effect of different treatments on beta carotene of drumstick leaves during storage

increased with increase in storage period. The rate of increase was less in drumstick packaged in T_7, T_6 and T_4 than T_2, T_3 and T_5 and control (T_1). Comparing the effect of thickness of packaging material, 350 gauge thick polyethylene (T_7) was found to be the best in reducing the rate of decrease of bacteria. The bacteria load on 12th day of storage for T_4, T_6 and T_7 were 5.18×10^6, 5.96×10^6 and 5.13×10^6, respectively.

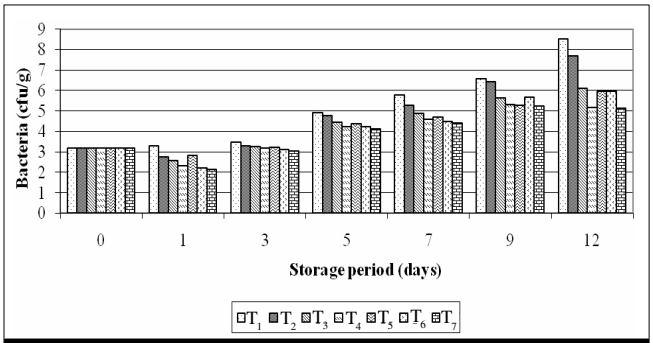

Fig.6: Effect of different treatments on bacterial load of drumstick leaves during storage

Fungi load :

From the Fig. 7 it was observed that fungi population

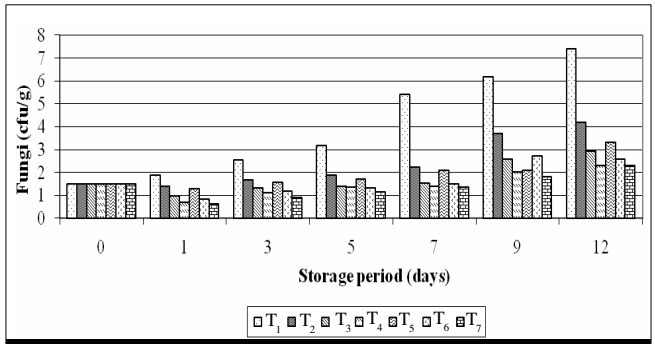

Fig.7: Effect of different treatments on fungal load of drumstick leaves during storage

increased with increase in storage period. The rate of increase was less in drumstick packaged in T_7, T_6 and T_4 than T_2, T_3 and T^5 and control (T_1). Comparing the effect of thickness of packaging material, 350 gauge thick polyethylene (T_7) was found to be the best in reducing the rate of decrease of fungi. The fungi load on 12th day of storage for T_4, T_6 and T_7 were 2.3×10^4, 2.6×10^4 and 2.29×10^4, respectively.

Conclusion :

The study clearly revealed that the drumstick leaves pretreated with 150 ppm of sodium hypo chlorinated (NaOCl) solution, air dried, packaged in 350 gauge polyethylene has expressed good quality of product even after twelve days of storage period as compared to all other treatments. Colour values namely 'L' and 'a' has decreased and 'b' value increased irrespective of storage method and condition. Similarly, both ascorbic acid and beta carotene content decreased with increase in storage period. In contradict to the above observation the microbial count has increased with increase in storage period, this accounts for the spoilage of the product. Among the three packaging materials, the leaves packaged under 350 gauge poly ethylene expressed good barrier property in minimising the quality loss compared to other two materials. The study also suggests the farmers and processing bodies to follow above processing method which will keep the drumstick leaves for minimum of nine days without any quality change and make the product available at all the places and times, in-turn yields in more profit and low risk

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