I J T A
© Serials Publications
National Academy of Agricultural Science (NAAS) Rating : 3. 03

Influence of Packaging Materials on the Shelf Life of Fresh Cut Beans

Thushara. T. Chandran[1]*, Dr. Mini. C.[1] and Dr. Geetha Lekshmi. P.R[1]

Abstract: *Good quality beans was surface sanitized using 30 ppm sodium hypo chlorite solution, outer strings removed, washed and fresh cuts were made, pretreatedwith 1% calcium chloride solution, air dried and packaged under different packaging materials and stored under refrigerated storage. Analysis of physical, physiological and chemical quality parameters and microbial revealed that vacuum packaging in laminated pouches as the effective packaging material for fresh cut beans.*

Keywords: *Beans, fresh cut vegetables, packaging materials, shelf life.*

INTRODUCTION

Consumer demand for high quality foods requiring only minimum effort and time for preparation has led to the introduction of ready-to-use fresh- cut products/ minimally processed foods.Minimal processing technique has emerged to meet the challenge of replacing traditional methods of preservation while retaining and nutritional and sensory quality. Fresh-cut products are fruit or vegetables that have been trimmed and/or peeled and/or cut into 100 percent usable product that is bagged or prepackaged to offer consumers high nutrition, convenience, and flavor while still maintaining its freshness [10]. But they are highly perishable due to damaged and exposed tissues and lack of protective skin. Application of partial processingincreases perishability due to increased metabolic activities and decompartmentalization of enzymes and substrates which may cause browning, softening, and off-flavor development [20, 15]. Modified atmosphere packaging (MAP) can extend storage life of fruits and vegetables by controlling respiration rate, senescence and ripening [21] and can also decrease the rate of browning reactions due to reduced O_2 level and elevated CO_2 level in the surrounding atmosphere [9]. Physical and physiological parameters differed significantly among different packages used to control undesirable physiological and physical changes that adversely affect quality of fresh cut products [7]. The advance in food technology and packaging technology has made it possible to extend the shelf life of these products unto few years.The most important function of packaging is to deliver to the consumers, food of the same quality he is used to getting in fresh foods or freshly prepared foods. Today's food marketplace is alive with new products and changing trends, and fresh-cut produce remains at the top of the list of products meeting the needs of today's busy consumers [12]. Hence an experiment was conducted to study the effect of different packaging materials on the shelf life of fresh cut beans.

MATERIALS AND METHODS

Fresh and good quality beans at correct maturity was procured from FSRS, Sadananthapuram wereused for the study. Harvested beans were washed in tap water, followed by distilled water and subjected to surface sanitization using 30 ppm sodium hypo chlorite solution [3] for 10 minutes.Sanitizing solution was drained after 10 minutes, outer strings removed, washed again in distilled water and made into uniform cut piecesusing vegetable cutter. Fifty grams of treated fresh cut beans were completely immersed in 1% calcium chloride [4] for 15 minutes.The solution

[1] Department of Processing Technology, College of Agriculture, Vellayani, Kerala Agricultural University (Kerala) India
[1*] Corresponding author, *E-mail* : *thush.chandra@gmail.com*

was drained;cuts air dried and 100g beans shreds were weighed and packed in following different packaging materials stored under refrigerated condition (5-7°C) for finding the most effective packaging material for extending the shelf life of fresh cut beans. T_1-unventilated PE cover (150 gauge), T_2-unventilated PP cover (100 gauge), T_3-micro ventilated PE cover (150 gauge), T_4- micro ventilated PP cover (100 gauge), T_5-polystyrene tray with cling film, T_6-MAP in laminated pouches and T_7-Control. In treatments from T_1 to T_4 fresh cut vegetables were packaged in plastic PE/PP covers of 0.18m^2 area. In treatments T_3 and T_4 covers of similar size were perforated by making total six pores on both sides of the packages. In T_6MAP was done in laminated pouches using a laboratory model vacuum packaging machine (Sevana's sevol V vacuum packing machine QS 400 MG (MC). Physical, physiological and chemical quality parameters of fresh cut beans were analyzedon the first, third and fifth day of storage and average worked out to find out the most effective packaging material for increasing the shelf life.

The treated packaged cut beans were steamed for 60 seconds and physical parameters like color, texture, appearance, flavor and taste of the steamed cuts were examined on the thirdday of storage by conducting a sensory evaluation trial performed by a 30 member semi - trained panel using a nine point hedonic scale [18].

Physiological parameters like physiological loss in weight (PLW), water potential and percent leakage of the packaged beans shreds were recorded on alternate days for five days of storageusing standard techniques.

Physiological loss in weight was determined on initial weight basis using a laboratory level weighing balance and expressed as percentage.Water potential of packaged shreds was estimated using Chardakov's method [16]and expressed in Mega Pascals. Fresh cut beans from each packageswere dipped in distilled water for three hoursand absorbance of distilled water was recorded at 273nm, shreds were heated in water bath at 100°C for 20 minutes and absorbance was again recorded at 273nm. The ratio of initial and final absorbance values was recorded as percent leakage[16].

Chemical parameters like starch, vitamin C, carotenoids [17] and total phenol [16] of treated packaged beans were recorded on alternate days for five days of storage.

Comparatively more important quality parameters were given more weightage and selection index was calculated by conducting discriminal function analysis for finding the superior four packaging materials for further microbial analysis using serial dilution spread plate technique [11]. Whole beans were surface sanitized using 30 ppm sodium hypochlorite, cuts prepared, treated with standardized 1% calcium chloride and microbial count on one gram treated and packaged beans sample was calculated once in two days for five days.Based on the efficiency in controlling microbial population to the lowest level, best effective packaging material for increasing the shelf life of fresh cut beans was selected.

The scores given by 30 judges in the panel during sensory evaluation were converted into mean rank values and statistically analyzed using the non-parametric anova (Kruskall Wallis test) and mean ranks and critical values were calculated for the quality parameters evaluated. Physiological and chemical observations were analyzed statistically in a Completely Randomized Design and significance was tested using analysis of variance technique [6].

RESULTS AND DISCUSSION

Physical and Physiological Parameters

Minimally processed food products are highly perishable; such products are prepared, and packaged to maintain their freshness and provide convenience to the user. Packaging materials have significant effect in reducing microbial population of fresh cut products [19]. Packaged cut materials are subjected to many stresses including deterioration reactions of wounded or senescing tissues, decay caused by growth of microorganisms, water loss from tissue, increase in respiration and ethylene production. These injuries induce severe damage and stress with considerable reduction in shelf life of commodity.

Packaging of fruits is to assemble the produce inconvenient units to protect it from deterioration during its handling from farm gate to consumer's house [14]. Adequate and proper packaging protects the fruits from physical (firmness), physiological (weight) and pathological (decay) deterioration. Effect of different packaging materials on physiological and physical quality parameters of fresh cut beans showed significant difference (Table 1and 2).

Table 1
Effect of packaging materials on physiological parameters of fresh cut beans

Packaging materials	*Physiological loss in weight (%)*	*Water potential (MPa)*	*Percent leakage*
Unventilated PE	1.26	0.14	85.67
Micro ventilated PE	2.12	0.14	77.44
Unventilated PP	1.81	0.14	78.18
Micro ventilated PP	1.26	0.14	78.73
Polystyrene tray	1.16	0.24	77.04
MAP in laminated pouches	0.67	0.28	76.90
Control	7.05	0.11	91.76
CD (P = 0.05)	0.11	0.04	0.98

In the present experiment when different packaging materials were compared, modified atmospheric packaging was found superior in performance for all the physiological parameters evaluated for fresh cut beans.Any fresh cut vegetable should have low physiological loss in weight to have high water potential, there by exhibiting freshness and turgidity. An efficient packaging material should help in retention of these characters throughout the storage period. In general modified atmospheric packaging system *viz*., vacuum packaging had low physiological loss in weight and percent leakage and hence had higher water potential (Table 1). This is in accordance with the findings of [5] who had reported that minimally processed jack fruit bulbs under vacuum packaging showed least physiological weight loss compared to conventional packaging.

Improved physiological parameters are the result of low transpiration and respiration rate of vegetable shreds under modified atmospheric condition. Comparing physiological parameters, physiological loss in weight was least (0.67) for the sample packed MAP. Maximum water potential (0.31) was observed for sample kept in MAP (0.28) and similarly shredded beans under MAP packaging had the least percent leakage (76.79) which was on par with samples packaged in polystyrene tray (77.04) and micro ventilated PE (77.44). This was supported by [13] who revealed that the commercial use of modified atmospheric packaging (MAP) provides the means to slow down the process of ripening and senescence by retarding the rate of respiration, transpiration and ethylene evolution and thus subsequently ensuring in better quality retention during storage, transport and marketing.Maximum weight loss (7.05), and lowest water potential (0.11) was reported in unpackaged samples resulted in higher percent leakage (91.76) in fresh cut beans.

Vegetable shreds with good physiological parameters were naturally fresh looking and hence had high score in physical parameters like appearance and texture in sensory scoring. In the present study mean rank value for appearance (72.15), color (70.65), flavor (69.40), texture (69.80) and taste (70.50) was maximum for samples under MAP in laminated pouches and similarly in case of appearance (54.75), flavor (53.70) and texture (51.70) the mean rank values are on par with the shreds packaged in polystyrene tray. For all the physical parameters evaluated the least (5.90) mean rank value was for the shredded beans without any packaging and hence scored least overall acceptability for physical parameters like color and texture.

CHEMICAL PARAMETERS

Chemical quality parameters viz., starch, vitamin C, carotenoid and total phenol were influenced by different packaging materials used for fresh cut beans.

Shredded beans in laminated pouch under MAP packaging showed maximum (4.08) starch content which was on par with the sample packed in polystyrene tray (3.89). Vitamin C content was maximum (9.71) for shredded beans subjected to MAP which was on par with the samples packed in polystyrene tray (9.57) and in micro ventilated PP (9.44). Maximum starch and vitamin C in modified atmospheric packaging was in conformity with the

Table 2
Effect of packaging materials on physical quality parameters of fresh cut beans

Packaging materials	*Mean rank values*					
	Appearance	*Colour*	*Flavour*	*Texture*	*Taste*	*Overall acceptability*
Unventilated PE	23.00	30.75	29.80	36.65	34.40	23.55
Micro ventilated PE	28.45	30.75	32.25	25.25	37.20	25.40
Unventilated PP	27.90	30.75	37.15	27.10	29.80	37.20
Micro ventilated PP	37.90	34.55	32.25	38.80	40.00	38.60
Polystyrene tray	54.75	49.75	53.70	51.70	42.80	53.25
MAP in laminated pouches	68.85	70.35	63.95	68.60	63.50	69.10
Control	11.00	6.45	5.50	6.10	5.80	5.90
CV	20.36					

results of [5] who had reported that the vacuum packaging technique with excluded air (O_2) from the package headspace influenced the retention of ascorbic acid in minimally processed jack fruit bulbs compared to the conventional packaging techniques. In shredded beans, polystyrene tray was also effective in maintaining a high starch content. Unventilated PE and micro ventilated PP were also effective in maintaining a high vitamin C in beans. The least starch and vitamin C was recorded by the unpackaged sample. Unventilated PP and PE recorded a similar and lower vitamin C in beans which was supported by Amith [1] that unventilated or micro ventilated PE or PP are poor packaging materials as it reduced the nutrient content of fresh cut papaya, mango, pomegranate and pineapple.

Highest carotenoid (133) was for shredded beans packaged under MAP. Due to the higher carotenoid content of MAPsamples they had good color and appearance and they scored high mean rank values for physical parameters when scoring was conducted. Lowest carotenoid (116) was for the unpackaged shredded bean which was on par with sample packaged in micro ventilated PE (119).

Total phenol was least (23.67) for sample packaged in laminated pouches under MAPand this least phenol content was due to least enzymatic browning which favored the samples to score higher mean rank values for appearance and color during sensory scoring. Highest (64.73) phenol content and least carotenoid (116) content were recorded in the unpackaged shreds whichresulted in poor rank value for texture and color during sensory test. Micro ventilated and unventilated PE recorded a similar and lower carotenoid content in beans.Retention of nutritional quality parameters like increased carotenoid, starch and vitamin C was noticed in fresh cut beans packaged under modified atmosphere packaging. This was supported by [8] that the quality of fresh-cut tomato slices during cold storage under various MAP conditions, and MAP provided good quality tomato slices with a shelf life of two weeks or more at 5°C.

Based on comparatively different chemical and physiological parameters, the top ranking four packaging materials were selected by conducting discriminal function test for each shredded packages, based on which selection index of different packages was determined. Based on selection index, the packaging materials like MAP in laminated pouches, polystyrene tray with cling film and micro ventilated PP and micro ventilated PE were selected as the top four packaging materials and subjected to microbial analysis.Bacterial counts on fresh cut beans packaged in selected packaging materials are shown in Table 4.

Table 3
Effect of packaging materials on chemical quality parameters of fresh cut beans

Packaging materials	*Starch (%)*	*Vit. C (mg/100g)*	*Carotenoid (μg/100g)*	*Total phenol (mg/100g)*
Unventilated PE	3.48	8.72	123.00	56.17
Micro ventilated PE	3.68	9.29	119.00	54.37
Unventilated PP	3.62	8.66	122.00	56.42
Micro ventilated PP	3.59	9.44	125.00	53.8
Polystyrene tray	3.89	9.57	130.00	47.12
MAP in laminated pouch	4.08	9.71	133.00	23.67
Control	2.79	8.47	116.00	64.73
CD (P = 0.05)	0.33	0.43	3.00	1.27

Table 4
Microbial count on beans shreds treated with superior treatments

Packaging materials	*Bacterial count × 10^4 cfu/g*
Micro ventilated PP	1.45
Polystyrene with cling film	1.43
Micro ventilated PE	1.45
MAP in laminated pouches	1.15
CD (P = 0.05)	0.012

When microbial population was analyzed, MAP in laminated pouches wasfound effective in reducing the microbial population compared to micro ventilated PP, PE and polystyrene tray. As microbial count was significantly low under refrigerated condition, influence of low temperature in inhibiting microbial growth on fresh cut products [2]. In the present study, considering the physical. physiological, chemical and microbial population MAP in laminated pouches was selected as the best effective packaging material for extending the shelf life of fresh cut beans. So fresh cut beans sanitized with 30ppm sodium hypochlorite solution, pretreated with 1% calcium chloride and packaged in laminated pouches under MAPwas found safe for storage upto for 7 days.

REFERENCES

Amith, P.K. (2012). Protocol development for fresh cut fruits and fruit mix. MSc (Hort.) thesis. Kerala Agricultural University. Thrissur. 125p.

Bacts, J. A. and Tamplin, M. L. (2002). Sales of vegetables for hazard analysis and critical control point and sanitation. In. Bacts, J.A and Brecht, J.K (Eds) *Postharvest physiology and pathology of vegetables* . Marcel Dekker, New York. pp.563-580.

ChandranThushara, T. and Mini, C. (2014). Effect of pre storage treatments on the shelf life of fresh cut carrots. *Internat. J. Proc. & Post Harvest Technol.*, **5**(2): 114-119

Chandran, T.C. (2013). Protocol development for fresh cut vegetables. MSc (Hort) thesis. Kerala Agricultural University. Thrissur. 187p.

Gayathri, R. (2013). Studies on morphological characterization, in vitro culture and minimal processing of bulbs, in some elite clones of jack fruit (Artocarpusheterophyllus L)., MSc (Hort) thesis. University of Horticultural Sciences. Bagalkot. 124p.

Gomez, K.A. and Gomez, A.A. (1984). Statistical proceedings for agricultural research (2nd ed. John Willey and Sons Inc., Singapore, 262p

Gonzalez-Aguilar, G. A., Ruiz-Cruz.S., Cruz-Valenzuela, R., Rodriguez-Felix, A. and Wang, C.Y. (2004). Physiological and quality changes of fresh cut pineapple treated with anti-browning agents. *Lebensm- wiss Technol*. **37**, 369-376.

Hong, J. H. and Gross, K. C. (2001). Maintaining quality of fresh cut tomato slices through modified atmospheric packaging and low temperature Storage. *J. Fd Sci.* **66**: 960-965.

Herner, R.C. (1987). High CO_2 Effects on plant organs. Ch. 3 in *Postharvest Physiology of Vegetables*, J. Weichmann (Ed.), p. 239–254. Mercel Dekker,Inc., New York and Basel.

IFPA, The International Fresh cut Produce Association. 2004. IFPA homepage (online). Fresh cut facts. http:/ /www. Freshcuts.org.

Kramer, J. M. and Gilbert, R. J. (1978). Enumeration of micro-organisms in food: a comparative study of five methods. *J. Hygiene*. **81**: 151-159.

Lamikanra, O. (2002). Fresh cut fruits and vegetables, science technology and market. Boca Raton, Florida, CRC Press. LLA.

Mattheis, J. and Fellman, J. K. (2000). Impacts of modified atmosphere packaging and controlled atmosphere on aroma, flavour and quality of horticultural commodities. *Hort. Technol.*, **18**: 507-510.

Neeraj, J. M. S. and Bhatia, S. K. (2003). Use of plastics in fruit packaging :*A review*. *Haryana J. Hort Sci.,* **32**: 1-8.

Rolle, R.S. and Chism, G.W. (1987). Physiological consequences of minimally processed fruits and vegetables. J. Food Qual. **10**: 157–165.

Sadasivam, S. and Manikam, A. (1992). Biochemical methods for agricultural science.Wiley Eastern Ltd. New Delhi. 246p.

Saini, R. S., Sharma, K. D., Dhankar, O. P. and Kaushik, R.A. (2001). *Laboratory manual of analytical techniques in horticulture*. AgroBios. India. 135p.

Stone, H., Bleibaum, R. and Thomas, H.A. (2012). *Sensory evaluation practices*. Academic Press. 446p

Varghese, S. (2006). Standardization of minimal processing techniques for selected vegetables.MSc (Hort.) thesis.Kerala Agricultural University.Thrissur. 89p.

Watada, A.E., Abe, K., and Yamuchi, N. (1990). Physiological activities of partially processed fruits and vegetables. Food Technol. **44**(5): 116–122.

Zagory, D. and Kader, A.A. (1988). Quality maintenance in fresh fruits and vegetables by controlled atmosphere. Ch. 14 in *Quality Factors of Fruitsand Vegetables*, J.J. Jen (Ed.), p. 174 188.American Chemical Society, Washington, DC.

■■■