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Retail Packaging of Cabbage

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Abstract

At 6 days from treatment, most of the unpacked and packed cabbage heads except those Cling-wrapped had moderately reduced visual quality. Also noted were the rotting of the butt-end and the cabbage head which were fastest in cabbage packed in polyethylene bag (PEB) and slowest in cabbages in cellophane- Leaf yellowing was similarly fast in cabbages in PEB and slowest in Cling-wrapped cabbages. At 9 days from treatment, weight losses ranged from 0.34 to 3.64% in cabbage heads in the various film bags relative to a 10.49% weight loss registered by the unpacked cabbages. Though not significant, only MA Bagging C delayed the onset of decay. MA Bagging C and D as well as Cling wrap slightly improved the shelf-life of the cabbage heads. Retail packaging in film bags/overwrap can be beneficial for a period of 5 days after which trimming of the cabbage heads become necessary.

Keywords: plastic packaging, shelf-life, postharvest quality

Introduction

Cabbage (Brassica oleracea var. capitata) is one of the most important vegetable crops of the world, being grown mostly by market gardeners, Yuck gardeners and home gardeners (Salunkhe and Desai, 1984). Other farmers grow it for processing, vegetable forcing (off-season production) and for seeds (Soriano and Villareal, 1986). The magnitude of postharvest losses in vegetables is known to reach staggering proportions depending on certain preharvest and postproduction factors. The market quality of cabbage and other cruciferous crops is observed to be maintained with difficulty after harvest. Postharvest losses can be caused by reduced visual quality due to diseases (Estrada et al., 1988; Bayogan et al., 1998) yellowing, wilting and weight losses. A factor that affects market quality of cabbages and other perishable crops is the kind of consumer or retail package used. At present, various flexible film bags/overwraps, known collectively as plastics for consumer packaging of vegetables are available. Plastics are any of numerous organic synthetic

materials that are molded, cast extruded or laminated into objects, films and filaments. The appeal of these materials has been due to their low cost, ease of use, and good optics (Barmore, 1987). In addition, recent advancements in co-extrusion technology have allowed for the manufacture of materials with designed transmission rates for oxygen (Barmore, 1987). Plastics, specifically polyethylene, are so common that nearly 10 million tons of it are produced in the United States each year, these are not only for bags for fruits and vegetables but for a myriad of other uses such as toys, squeeze bottles and a hundred other uses (Schwartz, et al., 1994). In some products, plastic packaging has benefited from its moisture barrier properties and thus help retain acceptable appearance and market quality for a time. Less transpiration losses occur thus delaying product deterioration. This experiment was conducted to evaluate the postharvest quality of cabbage heads (cv. Scorpio) packed in various commercially available film packages.

Materials and Methods

Newly-harvested, medium cabbage heads (cv. Scorpio) were trimmed and packed in different film packages. All wrapper leaves were t-immed from each cabbage head prior to packaging. The treatments were: T_1 — Unpacked, in ambient; T_2 — Modified Atmosphere (MA) Bagging C; T_3 — MA Bagging D; T_4, — Aisaka Ever Fresh Bag (green); T_5 — Cling Wrap; T_6 — Polyethylene Bag and T_7 — Cellophane. All treatments allow a clear view of the crop and have brand identification except for T_1, T_6 and T_7, MA Bagging C and D are Japanese-made film bags while Aisaka Ever Fresh Bag was purchased in a Manila supermarket. The other 3 film packages were purchased from a supermarket in La Trinidad, Benguet.

Trimming was done as the cabbage head showed moderate rotting (i.e., 25% of surface area of the head showing rotting). All treatments except MA Bagging C and MA Bagging D were replicated five times. MA Bagging C and D consisted of 4 and 3 replications, respectively. The experiment was laid out using a completely randomized design with unequal replications. Means were compared at 5% level of significance using DMRT.

All the cabbage heads were taken out from the package after eighteen days. Relative humidity (RH) ranged from 76.6 to 95.4% while temperature ranged from 20.3 to 22.2^{0}C.

Visual quality was rated using the Hedonic scale where: I — non-

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edible; 2- poor, limit of salability; 3-4 fair, defects progressing 5-6 good, defects moderate; 7-8, very good, defects slight; and 9-excellent. Degree of rotting and yellowing were determined separately by noting the surface area of the butt-end and head showing decay/yellowing. A scale of I to 5 was used where: V no rotting/no yellowing; 2— I to 19% of surface area shows rotting/ yellowing; 3 — 20 to 39%; 4- 40 to 59%; and 5 — 60% or more of surface area shows rotting/yellowing.

The percentage of weight loss of the cabbage head was obtained at regular intervals and compared with the initial weight taken at experiment set-up. Percentage of trimming loss was the weight of the undesirable plant parts that were trimmed. Trimming was done to remove deteriorated or decayed portions in order to attain a saleable quality. The number of times trimming was also noted. First trimming was done when the heads have exhibited evident rotting, yellowing and significant wilting.

Shelf - life of cabbage heads was terminated when after the last trimming the cabbage sustained about 25% surface area/butt-end rotting and 40% yellowing. At this time, defects progressed and further trimming no longer warranted salability.

Results and Discussion

Visual quality rating. The cabbage heads were initially of very good quality (Table l). Defects like rotting of head and butt-end, yellowing, insect damage and wilting of outer leaves (i.e., observed in unpacked heads) made trimming necessary to enhance quality and assure market acceptability (Bautista, 1987). Close trimming usually removed most of the infection (Salunkhe and Desai, 1984).

Most of the packed cabbage heads needed to be trimmed within a week of holding in order to improve visual quality. It appears that Cling-wrapped cabbages necessitated trimming the latest at 10 days of holding. Unpacked cabbages were trimmed the earliest at 4 days of holding. The heads in MA Bagging C, D, Aisaka Ever Fresh, PEB, Cellophane were trimmed after 6 days of holding after which trimming was done at 2 days interval (i.e., 8 and 10 as indicated by higher VQR.

Thus, good visual quality was noted after trimming in all heads except those packed in polyethylene bag (PEB) which rated fair quality 11 days from treatment. MA Bagging C and D as well as Aisaka Ever Fresh are commercial products of modern extrusion technology where micropores are present in

the package that allow for low transmission of gasses to maintain quality (Barmore, 1987). These however did not significantly improve VQR relative to the unpacked control and the cheaper PEB and Cellophane.

Table 1. Visual quality rating (VQR) of cabbage heads packed in various film bags

Treatment	Visual Quality Rating Storage Time (days)										
	2	3	4	5	6	7	8	9	10	11	12
Unpacked	8.0a	5.6a	6.0a	5.4a	5.3a	6.5a	5.3a	5.0ab	4.3ab	6.0a	4.0a
MA Bagging C	8.0a	7.0a	7.0a	7.0a	5.8a	6.0a	5.3a	4.3bc	3.0b	5.5ab	3.5a
MA Bagging D	8.0a	7.0a	7.0a	7.0a	4.7ab	5.7a	3.6a	4.5abc	3.5ab	5.0b	3.5a
Aisaka Ever Fresh	8.0a	7.0a	6.8a	5.8a	5.5a	6.3a	4.8a	5.0ab	3.7ab	5.5ab	3.5a
Cling Wrap	8.0a	7.0a	6.6a	6.4a	5.8a	5.6a	4.6a	3.2c	2.4b	5.0b	4.0a
Polyethylene Bag	8.0a	6.2a	6.4a	5.6a	3.5b	6.5a	4.0a	6.0a	5.0a	4.0c	4.0a
Cellophane	8.0a	6.6a	6.0a	5.6a	6.0d	6.5a	5.3a	3.5bc	3.5ab	4.0c	3.5a

Means in a column with common letters are not significantly different at P=0.05 using DMRT

Degree of rotting of the butt-end. Rolling of the butt-end was low. No rotting of butt-end (equivalent to a rating of 1.0) was observed on the first two days of holding from all treatments (Table 2). As in VQR, degree of rotting was slightly reduced due to trimming as indicated by the lower decay ratings on day 6 in the control cabbages as well

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Table 2. Degree of rotting of the butt-end of the cabbage heads

Treatment	Degree of Rotting Storage time (days)									
	3	4	5	6	7	8	9	10	11	12
Unpacked	1.6a	1.2a	1.2a	2.0b	1.0b	1.0b	3.0c	3.3c	2.6a	3.3cd
MA Bagging C	1.0a	1.3ab	1.3a	1.3b	1.3b	2.5ab	3.8b	4.3ab	3.5ab	3.5c
MA Bagging D	1.0a	1.0b	1.0a	2.3ab	1.3b	3.0a	3.0c	4.0abc	3.0a	3.5c
Aisaka Ever Fresh	1.0a	1.2ab	1.2a	2.0b	1.0b	2.3ab	3.0c	4.0abc	3.8a	4.5ab
Cling Wrap	1.0a	2.0a	2.0a	2.2b	2.6a	2.6ab	4.2a	4.6abc	5.0a	5.0a
Polyethylene Bag	1.4a	1.8ab	1.8a	3.0a	1.0b	2.5ab	3.0c	4.0abc	4.6a	3.5c
Cellophane	1.2a	1.8ab	1.8a	2.0b	1.0b	2.0b	2.0d	3.5bc	3.8a	2.5d

Means in a column with common letters are not significantly different at P=0.05 using DMRT

as those packed in MA Bagging D, Aisaka Ever Fresh, PEB and Cellophane, Cling wrapped cabbages were not trimmed until the eleventh day of holding, thus the relatively high decay ratings of the butt-end.

Degree of rotting of head. Cabbage heads packed in various film bags attained the same percentage of head rotting during the first three days (Table 3) with no rotting (equivalent to a rating of 1.0) noted on the first two days of holding (data not shown). Heads placed in polyethylene bags registered 40 to 59% surface rotting after 6 days. This necessitated trimming to attain better market quality thus the lower degree of rotting noted the day after.

Table 3. Degree of rotting of the cabbage heads

Treatment	Degree of Rotting Storage time (days)									
	3	4	5	6	7	8	9	10	11	12
Unpacked	1.6a	1.2a	1.2a	2.3bc	1.0b	1.0c	3.0b	3.3ab	2.6a	3.3a
MA Bagging C	1.0a	1.3a	2.4a	2.0c	1.0b	2.0bc	3.0b	4.0ab	3.5a	3.0a
MA Bagging D	1.0a	1.2a	2.4a	3.0abc	1.5ab	3.0abc	3.4ab	4.0ab	3.8a	3.0a
Aisaka Ever Fresh	1.0a	1.2a	2.4a	3.3ab	1.5ab	3.0abc	3.4ab	4.0ab	3.8a	3.0a
Cling Wrap	1.0a	1.2a	1.4a	2.4bc	2.4a	2.8abc	3.8a	4.4a	4.4a	2.0c
Polyethylene Bag	1.0a	1.0a	2.0a	4.0a	1.5ab	3.5a	3.0b	4.0ab	4.4a	3.0a
Cellophane	1.0a	1.4a	1.4a	2.5bc	2.0a	1.8c	2.8b	3.0b	3.0a	2.5b

Means in a column with common letters are not significantly different at P=0.05 uisng DMRT

Yellowing. The cabbage heads slowly changed their green color to yellow (Table 4). All the cabbage heads were green during the first two days of evaluation. Yellowing appeared slightly faster in cabbage heads packed in MA Bagging C at day 7. On the eighth day, cabbage heads in polyethylene bag exceeded 40% yellowing of the surface area.

Percentage weight loss. A significantly higher weight loss was registered by unpacked heads placed under ambient conditions compared to those packed in plastic films (Table 5). On day 12, the cabbages in all the treatments sustained similar weight losses ranging from 3.77 to 11.30% with cabbages in Aisaka Ever Fresh Bag registering the lowest weight loss.

Table 4. Yellowing of cabbage heads

Treatment	Yellowing Storage Time (days)									
	3	4	5	6	7	8	9	10	11	12
Unpacked	1.6a	2.0a	2.2a	2.0b	3.3a	3.3a	3.8b	4.5a	4.5ab	4.8a
MA Bagging C	1.0a	1.0a	2.0a	2.0b	3.8a	3.8a	4.0ab	4.8a	4.5ab	4.5a
MA Bagging D	1.0a	1.0a	2.0a	2.0b	3.3a	3.7a	3.5b	3.5b	4.5ab	4.5a
Aisaka Ever Fresh	1.0a	1.0a	2.2a	2.0b	3.3a	3.5a	4.0ab	4.0ab	4.5ab	4.5a
Cling Wrap	1.0a	1.0a	2.0a	2.0b	2.4b	3.2a	4.2a	4.8a	5.0a	5.0a
Polyethylene Bag	1.0a	1.4ab	2.4a	3.0a	3.0ab	4.0a	4.0ab	4.0ab	4.0b	5.0a
Cellophane	1.0a	1.4ab	2.4a	2.0b	3.3a	3.3a	4.0ab	4.0ab	4.0b	4.5ab

Means in a column with common letters are not significantly different at P=0.05 using DMRT

Percentage of trimming loss. Cabbage placed on cellophane bags had the highest percentage of trimming loss. This was due to faster rotting of heads.

Table 5. Percentage of weight and trimming losses in cabbage heads

Treatment	Weight Loss (%) Storage Time (days)					Trimming Loss (%)
	3	6	9	12	15	
Unpacked	5.25a	10.00a	10.49a	11.30a	12.69a	50.75a
MA Bagging C	0.22b	0.33bc	0.62b	4.32b	5.52a	67.83a
MA Bagging D	0.48b	0.64bc	0.83b	5.09b	6.05a	77.68a
Aisaka Ever fresh	0.09b	0.06c	0.34b	3.77b	4.98a	71.25a
Cling Wrap	1.41b	2.21b	3.64b	4.98b	6.72a	87.81a
Polyethylene Bag	0.77b	1.13bc	0.05b	3.86b	5.41a	87.50a
Cellophane	0.59b	0.69bc	3.47b	5.59b	6.44a	88.65a

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Number of times of trimming. Though not significant, the control heads were trimmed twice relative to the heads in the other treatments which needed 1.2 to 1.5 times of trimming.

Days to 25% rotting. Only the heads in MA Bagging C exceeded the control lot by less than a day in reaching 25% rotting (Table 6). All the rest of the packages hastened rotting. The control heads reached 25% rotting in 15.6 days.

Table 6. Days to 25% rotting, number of times trimmed and shelf-life of cabbage heads

Treatment	Days to 25% Rotting	Mean Number of Times Trimmed	Shelf-life (days)
Unpacked	15.60a	2.00	16.40
MA Bagging C	16.25a	1.50	17.50
MA Bagging D	13.33a	1.33	17.00
Aisaka Ever Fresh Bag	12.20a	1.50	13.80
Cling Wrap	13.50a	1.50	17.00
Polycthylene Bag	10.40a	1.25	11.00
Cellophane	5.51a	1.20	14.20

Means in a column with common letters are not significantly different at P=0.05 using DMRT

Summary and Conclusions

As with many perishables, harvested cabbage heads undergo visual postharvest changes such as reduced over-all visual quality, onset of decay in either the butt-end or head portion, leaf yellowing and increased weight and trimming losses.

Visual quality deteriorated the fastest in cabbage heads in polyethylene bag (PEB) due to rotting. Visual quality deterioration was fastest next in heads in MA Bagging D. A good visual quality was maintained the longest in cabbages in MA Bagging C and those Cling-wrapped maintaining acceptable quality without trimming until after 10 days. The good visual quality in cabbages in MA Bagging C and Cling wrap was due either to delayed onset of decay on the cabbage heads or delayed onset of leaf yellowing.

Trimming generally improved visual quality but rotting in heads in film bags always made the disease symptoms evident again in both butt-end and head portion one day after trimming. Slowest yellowing was noted in

heads in Cling wrap. Weight and trimming losses tended to increase with time. Though not significant, the control lot registered the least trimming loss.

Retail packaging in film bags can be beneficial for a period of less than 6 days because of lesser weight loss and maintenance of good visual quality in all packages except PEB and MA Bagging D. Except for low weight losses and slightly better visual quality, keeping cabbages unpacked in 20.3 to 22.2 ^{0}C and 76.6 to 95.4% RH compared well with a number of commercially available film bags/overwrap. More benefits will be had if storage was done in cooler temperatures and with regular trimming and repacking. Perforations in the plastic package can also be beneficial.

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Literature Cited

Barmore, C.R. 1987. Packing Technology for Fresh and Minimally Processed Fruits and Vegetables. J. of Food quality.

Bautista, O.K. 1987, Proper Postharvest Handling of ASEAN Vegetables, fruits and Flowers, A Simplified Guide. PHTRC-UPLB.

Bayogan, E.V., E. F. Jimenez, C.B. Macario, Y. B. Botigan and O.K. Bautista. 1998. Losses due to Soft Rot in some Sub-tropical Vegetable Crops at the La Trinidad Trading Post. In: Evaluation of Losses and Appropriate Postharvest Handling Technologies in Some Sub-tropical Vegetable and Cutflower Crops. BSU, La Trinidad, Benguet. pp 29-38.

Estrada, A.B., L.L. nag, E.S. Borromeo, A.B. Agillon and O.K. Bautista. 1988. Reducing Postharvest Occurrence of Bacterial Soft Rot of Cabbage by Alum Treatment during Transport and Retail. Paper presented during the 6th FCSSP Conference, Davao City. April 27-29. 19pp-

Salunkhe, D. K. and B.B. Desai. 1984 Cole Crops. In: Postharvest Biotechnology of Vegetables. CRC Press Inc., Florida. 1: 157-180.

Schwartz, A.T., D.M. Bunce, R.G. Silberman, C.L. Stanitski, W.J. Stratton and A.P.

Zipp. 1994. The World of Plastics and Polymers. In: Chemistry in Context.

Applying Chemistry to Society. Wm. C. Brown Communications, Inc. U.S.A. pp.267-294.

Soriano, J.M. and R.L. Villareal. 1986. Types of Vegetable Production. In: Vegetable Production (O.K- Bautista and R.C. Mabesa, Eds.). UP Los Bafios, Laguna. pp.24-27.