ผลของบรรจุภัณฑ์แอคทีฟที่มีค่าอัตราการซึมผ่านของออกซิเจนแตกต่างกันต่อคุณภาพของต้นหอม (*Allium fistulosum*)

Effect of Active Packaging with Different Oxygen Transmission Rates on Quality of Bunching Onion (*Allium fistulosum*)

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Abstract

To select package films with suitable oxygen transmission rate (OTR) for maintaining quality, three types of polyethylene films with different OTR which had low OTR (9000-11000 cc/mg), medium OTR (12000-14000 cc/mg) and high OTR (14000-16000 cc/mg) were used to compare their effects on quality of bunching onions stored at 10˚C. Changes of physical and chemical parameters were determined just after treatment and at two-day intervals during storage. The present study showed that low OTR significantly reduced weight loss percentage and respiration rate as compared to the other two films. This was due to its low permeability and gas exchange which caused low levels of O_2 and, consequently, restricted respiration. However, curvature, internal leaf extension and ethylene production were not significantly different. The total chlorophyll content gradually decreased whereas the total carotenoid content gradually increased, but there was no significant difference among treatments. Sugar content in green tops was not significantly different till four days after storage but showed significant difference thereafter. At the end of storage, the highest total sugar content was found in the low OTR bag as a result of high CO_2 concentration. Thus, low OTR can maintain physical characteristics and the contents of chlorophyll and sugar; therefore, it should be selected for packaging of bunching onion.

Keywords: bunching onion, oxygen transmission rate, quality, physical and chemical parameters

Introduction

The onion (*Allium cepa* L.), both greens and bulbs, is one of the most important vegetables grown in the world due to its unique flavour. Bunching onions (*Allium fistulosum*) are widely used as seasoning in Thai and other oriental foods, such as salads, dips and soups. The fresh leaves of bunching onions are rich in vitamin C, a bioactive compound with antimicrobial effects. However, bunching onions have a high respiration rate and are very perishable, their postharvest life can be greatly reduced if they are handled and stored under improper conditions. Thus, it is requisite that an attempt be made to extend their shelf life after harvest. Active packaging performs functions of traditional packaging, such as providing barriers to moisture vapour and gases, preventing product contamination from outside and creating ease in food handling and identification (Ozdemir and Floros, 2004). Oxygen transmission rate (OTR) in package atmospheres helps to further improve produce properties and, consequently, product quality and shelf life of product traceability. Therefore, selecting package films with suitable OTRs plays an important role in developing modified atmosphere packaging for improved quality and shelf-life of fresh-cut produce. When film permeability is not appropriately matched to the produce respiration rate, O_2 may become depleted and CO_2 may become enriched within the package, leading to anaerobic respiration and, consequently, to fermentative volatile accumulation and off-odour development. Or, inadequate control of O_2 (too high) may increase oxidative browning and senescence. Therefore, this experiment was carried out to test the effects of polyethylene bags with different OTRs on quality of bunching onions during storage, and to select suitable OTR packaging film to maintain quality of bunching onions.

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Materials and Methods

Bunching onions were purchased from a wholesale market and sorted for defects, such as physiological disorders, pest and disease infection, mechanical damage and transport loss, and then they were graded for uniformity of size and color. After that, samples were washed with tap water. In this experiment, bunching onions were immersed in ice-water (4˚C) for about 30 minutes. After this treatment, the samples were dried at room temperature, and cut at the tip to be 28 cm in total length. These cut bunching onions (70 g units) were packaged with an electric sealer in plastic bags with different OTR, and were designated as low OTR (9000-11000 cc/mg), medium OTR (12000-14000 cc/mg) and high OTR (14000-16000 cc/mg). Bag size was 35 cm in length and 15 cm in width. The bags were stored vertically at 10˚C in a storage room with dark or light condition? During storage, quality and green life were evaluated at two-day intervals for changes of physical characteristics (weight loss, internal leaf extension, curvature, ethylene, and respiration rate) and chemical parameters such as total chlorophyll, total carotenoid (Arnon,1949), and total sugar (Dubois,1951).

Results and Discussion

Weight loss gradually increased in all treatments during storage (Figure 1), however, a significant difference was observed at the end of storage (D10). Among the three different OTR treatments, low OTR film gave the lowest weight loss, thus preventing weight loss and high OTR showed the highest weight loss. This may be due to the restriction of respiration rate caused by low O_2 concentration inside low OTR packaging. Ding *et al*. (2002), reported that non-perforated polyethylene (PE) bags reduced weight loss more effectively, as compared to perforated PE bags, and lower weight loss in different packages might be due to retention of moisture. Although, curvature and internal extension increased during storage, there were not significant differences among the different OTR films (Figure 2). Hong *et al*. (2000) stated that leaf curvature, and internal extension of bunching onions were the main causes of loss of visual quality, and this declined rapidly at 10°C. Geotropic curvature was best controlled by low temperature (0°C) or intermediate temperature (5°C) with low O_2 (0.1%) atmospheres. Kader (1986) showed that low O_2 and/or high CO_2 atmospheres inhibited growth phenomena, such as sprouting of onions and potatoes. This may be due to the reduction of normal respiratory activities which, in turn, may limit energy supply for growth-related events.

The respiration rate of bunching onions in different OTR films showed significant differences at D6 and D8 during storage (Figure 3). In these days, the low OTR bag had the lowest respiration rate and the medium OTR gave the highest at D6 and the high OTR bag showed the highest respiration at D8. The low OTR bag had low permeability and gas exchange, and thus caused low levels of O_2 and, consequently, restricted respiration. The ethylene concentration inside the three different films suddenly increased within 2 days after storage (D2) (Figure 3). In low OTR film, the ethylene production rate decreased at D4 and changed little thereafter, whereas in medium and high OTR bags, it increased till D8. Among the treatments, the ethylene content was not significantly different throughout the storage.

The total chlorophyll content of bunching onions packaged by different OTR films gradually decreased with storage time, but the differences of chlorophyll content among the treatments were not significantly different throughout the storage (Figure 4). The lowest chlorophyll degradation was found in the low OTR film package and the high OTR film gave the highest degradation at the end of storage. The degradation of chlorophyll is known to be catalysed by various specific enzymes, and the ability of these enzymes may not be affected on OTR in this experiment. The effect of different OTR film on total carotenoid content gradually increased with storage time, but showed no significant difference among the treatments in all observed days (Figure 4); however, the low OTR bag had the lowest content of carotenoids because low gas permeance bags inhibited the biosynthesis of carotenoids. The total sugar contents of bunching onions in green tops and pseudostem as affected by different

OTR films stored at 10°C are presented in Figure 5. The content of sugar in green tops was not significantly different till four days after storage, and showed significant difference thereafter during storage. At the end of storage, the highest total sugar content was found in low OTR bags and the lowest in high OTR bags. Weichman (1986) reported that sucrose accumulation was observed as a result of a CO_2 concentration much higher than the optimal one. In pseudostem, total sugar content gradually decreased with storage, and no significant difference was observed among the treatments.

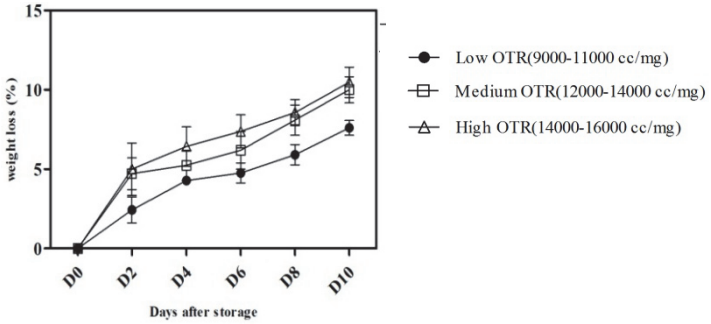

Figure 1 Effect of different OTR polyethylene films on weight loss % of bunching onions stored at 10˚C. Data represent means ± SE, of three replications.

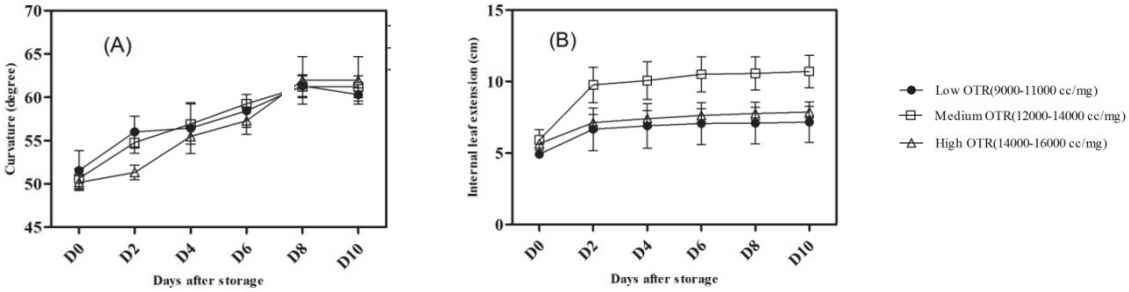

Figure 2 Effect of different OTR polyethylene films on (A) curvature and (B) internal leaf extension of bunching onions stored at 10˚C. Data represent means ± SE, of three replications.

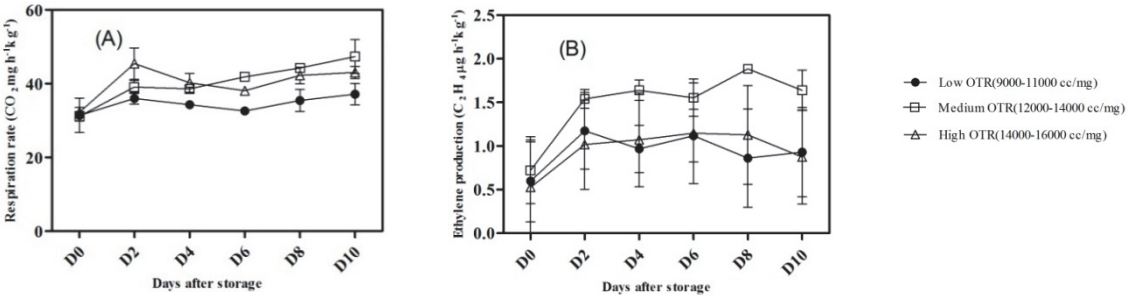

Figure 3 Effect of different OTR polyethylene films on (A) respiration and (B) ethylene production of bunching onion stored at 10 ˚C. Data represent means ± SE, of three replications.

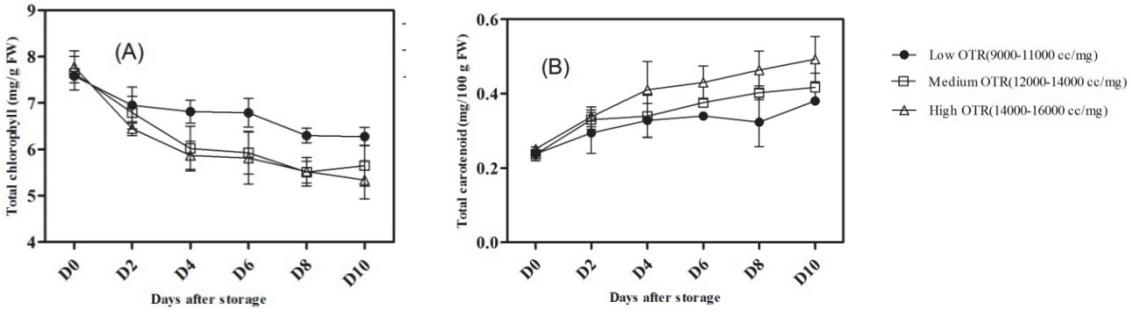

Figure 4 Effect of different OTR polyethylene films on (A) total chlorophyll and (B) total carotenoid of bunching onions stored at 10˚C. Data represent means ± SE, of three replications.

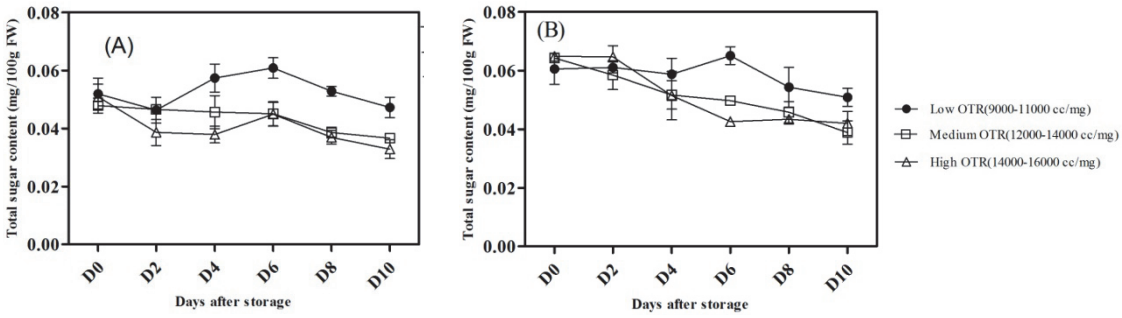

Figure 5 Effect of different OTR polyethylene films on total sugar of (A) green tops and (B) pseudostem of bunching onions stored at 10 ˚C. Data represent means ± SE, of three replications.

Conclusion

The present study showed that low OTR significantly reduced weight loss percentage and respiration rate as compared to the other two films, due to its low permeability and gas exchange and, thus, caused low levels of O_2 and, consequently, retarded respiration. However, curvature, internal leaf extension and ethylene production of bunching onions in three OTR films package were not significantly different. The total chlorophyll content and total sugar content of pseudostem gradually decreased whereas total carotenoid content gradually increased but no significant difference was observed among treatments. The content of sugar in green tops was not significantly different till four days after storage but was significantly different thereafter. At the end of storage, the highest total sugar content was found in low OTR bags as a result of low respiration rate and the lowest in high OTR bags. The low OTR could maintain physical characteristics and the contents of chlorophyll and sugar, therefore, it should be selected for packaging of bunching onions.

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