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RESEARCH ARTICLE

Efficacy of Edible Coating to Extend the Post-harvest Shelf-life of Shallot (*Allium ascalonicum)* Bulb

N. P. Minh[1*], N. Q. Thong[2], V. T. B. Lieu[2], D. T. Son[3]

1. *Faculty of Food Technology - Biotech, Dong A University, Da Nang City, Vietnam.*

2. *Can Tho University, Can Tho City, Vietnam.*

3. *Vinh Long University of Technology Education, Vinh Long Province, Vietnam.*

***Corresponding Author:** **N. P. Minh**

Abstract

Shallot or violet onion (*Allium ascalonicum)* bulbs are well known for their biological activity resulting from the presence of sulphur compounds. The health and nutritional benefits of shallot have led to their increased demand and hence production. Shallot harvest handling must be done immediately after harvest because these commodity are easily damaged. Plastic food packaging causes serious environmental problems. Edible coatings offer various physicochemical advantages for fruit and vegetable in preservation. Objective of this study focused on the effectiveness of different coating materials such as chitosan, CMC, xanthan gum, carrageenan, sodium alginate to the quality of shallot bulbs. Results showed that after 6 month storage by 3.0% chitosan at ambient temperature, shelf-life of shallot bulbs remained its stability. Edible coating could maitain shallot quality by controlling respiration rate as well as decay. It's not only as an effective strategy for the product but also friendly environment.

Keywords: *Shallot bulb, Allium ascalonicum, Chitosan, Coating, Storage, Shelf-life.*

Introduction

Shallot or violet onion (*Allium ascalonicum)* is a vegetable with high economic value. Carbohydrates in onion constitute about 80% of dry matter, and the major non-structural carbohydrate of onion bulb is fructo-oligosaccharides, well known as fructan, followed by glucose, fructose, and sucrose. The sugar concentration is associated with dormancy and storage life of onion, occurring as decrease in glucose, fructose and fructan, particularly towards the end of storage. High concentrations of quercetin, isorhamnetin, and their glycosides were also isolated and described [1].

The flavonoid fraction of *A.ascalonicum* bulbs had remarkable antibacterial and anticancer properties [2, 5]. It contains various organosulfur compounds which have antibiotic and anticarcinogenic properties and flavonoid like quercetin which is a valuable natural source of antioxidants. *Allium ascalonicum* had numerous therapeutic effects and health-enhancing properties such as cancer prevention [6, 7]. Bacterial soft rot caused by and is the main postharvest disease when the bulbs are infected with the bacteria and stored at room temperature [8].

The preservation of shallot is an important issue for both farmers and people who use shallot as a dietary additive, because of its unique fragrance [9]. In order to preserve the nutrients in shallots, after harvest, various protocols, including incubation, drying or lyophilization of the shallot are developed [10]. Effect of controlled atmosphere storage on abscisic acid concentration and other biochemical attributes of onion bulbs were verified [11].

Contents of certain chemical components in shallot bulbs after harvest and long-term storage were examined [12]. The effect of CA storage on quality of shallot bulbs was examined [13]. One study determined changes in the content of flavonoids in fleshy scales of shallot bulbs in relation to different compositions of atmosphere during storage. Also antioxidant activity of the bulbs was determined [14]. One research studied changes in the characteristics of shallot (*Allium ascalonicum* L) during *curing* prosess at a temperature of 45ºC ± 0.6ºC, and RH 69% ± 0.4% [15]. One research evaluated different aspects affecting to the fermentation of shallots such as concentration of $CaCl_2$, temperature and time for blanching; effect of ratio *Lactobacilus plantarum* to the antioxidant of fermented shallot [9]. Usage of edible coating is beneficial to protect nutritional components inside of food with a long durability.

A thin layer of edible materials which restrict loss of water, oxygen and other soluble material of food. Edible coatings are an eco-friendly technique, which slows deterioration of vegetables by controlling gas exchange, moisture transfer, and oxidation. Major advantage of these coatings is to improve nutritional and sensory quality of food by incorporating active ingredients into the polymer matrix that are consumed with food products [16].

Other advantages of edible coating are palatable, friendly, durable, bactericidal [17]. There are different kinds of films which are used such as protein, polysaccharide, lipid and composed films. The effect of an alginate-based coating biofilm on the physicochemical characteristics of Welsh onion (*Allium fistulosum* L.) provided evidence in favour of the replacement of plastic packaging used in post-harvesting process [18].

There was not any research mentioned to the application of edible coating for storage of shallot or violet onion (*Allium ascalonicum*). In order to provide evidence in favour of the replacement of plastic packaging or chemical treatment used in post-harvesting process, this study focused on the possibility of various edible coating films such as chitosan, CMC, xanthan gum, carrageenan, sodium alginate to maintain the quality of shallot bulbs during preservation.

Materials and Method

Material

Shallot bulbs were collected from Soc Trang province, Vietnam. After collecting, they must be conveyed to laboratory within 8 hours for experiments. They were subjected to process of cleaning, disinfection and sun drying for 3 days. The coating was applied at ambient temperature with different coating materials such as chitosan, CMC, xanthan gum, carrageenan, sodium alginate at 1.5%. After 6 month storage, the coated bulbs would be estimated the weight loss, dry matter, firmness, sensory, total phenolic, total flavonoid.

Researching Procedure

Effect of Different Edible Coating to Weight Loss (%), Dry Matter (%), Firmness (N), Total Phenolic (mg GAE/g Extract), Total flavonoid µg RE/g Extract) and Sensory of Shallot During 6 Month Storage

The coating was applied at ambient temperature with different coating materials such as chitosan, CMC, xanthan gum, carrageenan, sodium alginate at 1.5%. After 6 month storage, the coated bulbs would be estimated the weight loss (%), dry matter (%), firmness (N), sensory, total phenolic (mg GAE/g extract), total flavonoid (µg RE/g extract).

Effect of different Concentration of chitosan as Edible Coating to Weight Loss (%), Dry Matter (%), Firmness (N), Total Phenolic (mg GAE/g Extract), Total flavonoid µg RE/g extract) and Sensory of Shallot during 6 Month Storage

The coating was applied at ambient temperature with different concentration of chitosan (1.5%, 2.0%, 2.5%, 3.0%, 3.5%). After 6 month storage, the coated bulbs would be estimated the weight loss (%), dry matter (%), firmness (N), sensory, total phenolic (mg GAE/g extract), total flavonoid (µg RE/g extract).

Physico-chemical, Sensory and Statistical Analysis

Weight loss (%) was estimated by comparing the weight of shallot before and after treatment. Firmness (N) was measured by penetrometer. Total phenolic content (mg GAE/g extract) was determined using Folin-Ciocalteu assay [19]. Total flavonoid content (µg RE/g extract) was determined by the aluminium calorimetric method [20]. Sensory score was evaluated by a group of panelist using 9 point-Hedonic scale. The experiments were run in triplicate with three different lots of samples. Statistical analysis was performed by the Stat graphics Centurion XVI.

Result & Discussion

Effect of different Edible Coating to Weight Loss (%), Dry Matter (%), Firmness (N), Total phenolic (mg GAE/g Extract), Total Flavonoid µg RE/g Extract) and Sensory of Shallot During 6 Month Storage

Edible film coatings are widely used as a protective barrier for the reduction of transpiration and respiration, therefore reducing the ripening process in fruits and vegetables and improving their quality [21]. In our present study, different edibible coating films (chitosan, CMC, xanthan gum, carrageenan, sodium alginate) were examined. Our results were noted in table 1. Chitosan was noted as the best coating material among 5 ones.

Table 1: Quality of shallot during 6 month storage by different edible coatings at 1.5% concentration

Coating	Control	Chitosan	CMC	Xanthan gum	Carrageenan	Alginate
Weight loss (%)	9.43±0.02^{a}	4.08±0.01^{f}	6.78±0.03^{c}	7.41±0.05^{b}	5.25±0.013^{d}	4.79±0.03^{e}
Dry matter (%)	11.02±0.03^{f}	18.71±0.03^{a}	15.58±0.01^{d}	14.30±0.01^{e}	16.29±0.01^{c}	17.15±0.01^{b}
Firmness (N)	2.73±0.04^{d}	3.57±0.02^{a}	3.18±0.02^{bc}	3.02±0.02^{c}	3.33±0.02^{b}	3.40±0.02^{ab}
Total phenolic (mg GAE/g)	18.24±0.01^{e}	24.19±0.00^{a}	22.08±0.00^{c}	21.15±0.04^{d}	23.48±0.00^{b}	23.82±0.04^{ab}
Total flavonoid (µg RE/g)	7.35±0.02^{e}	15.20±0.02^{a}	12.37±0.04^{c}	11.25±0.01^{d}	13.31±0.04^{b}	14.42±0.01^{ab}
Sensory score	3.08±0.00^{e}	7.42±0.00^{a}	6.23±0.02^{c}	5.11±0.03^{d}	6.68±0.02^{bc}	7.02±0.03^{b}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Physical properties of alginate-coated onion (*Allium cepa*) skin was studied. The coated onion exhibited extended shelf life, reduced water loss and improved gloss [22].Contents of certain chemical components in shallot bulbs after harvest and long-term storage were examined. The contents of total sugars in shallot bulbs was on average 6.32% immediately after harvest and 5.71% after 5 months of storage. Long-term storage of shallot bulbs significantly affected the decrease of flavonoid contents, slight decrease of total sugars, but a significant increase of phenolic acids [12].

The effect of an alginate-based coating biofilm on the physicochemical characteristics of Welsh onion (*Allium fistulosum* L.) provided evidence in favour of the replacement of plastic packaging used in post-harvesting process. The onions were subjected to process of washing, disinfection and drying at 21 °C ± 0.2 °C. The coating was applied at (30 ° C) with a multi component matrix of sodium alginate ranging from 2% to 10%, glycerol (2%), Tween 20 (1%), and ascorbic acid (10%), which was cross-linked with calcium chloride (2%). 10% alginate edible biofilm showed a favorable effect over the onion regarding weight loss, pH and titratable acidity, compared to non-coated [18].

Effect of different Concentration of Chitosan as Edible Coating to Weight Loss (%), Dry Matter (%), Firmness (N), Total Phenolic (mg GAE/g extract), Total flavonoid µg RE/g extract) and Sensory of Shallot during 6 month Storage

Chitosan is a high-molecular-weight carbohydrate polymer produced by the deacetylation of chitin. It is widely applied in the storage of fruits and vegetables as a semipermeable film that regulates the internal atmosphere and reduces the transpiration, thus extending their shelf life [23]. In our present study, different concentration of chitosan (1.5%, 2.0%, 2.5%, 3.0%, 3.5%) were examined. Our results were noted in Table 2. The optimal chitosan concentration was recorded at 3.0%.

Table 2: Quality of shallot during 6 month storage by different chitosan concentration

Chitosan (%)	1.5	2.0	2.5	3.0	3.5
Weight loss (%)	4.08±0.01^{a}	3.25±0.03^{ab}	3.02±0.02^{b}	2.47±0.03^{bc}	2.40±0.00^{c}
Dry matter (%)	18.71±0.03^{c}	19.15±0.01^{b}	20.37±0.04^{ab}	21.03±0.01^{a}	21.09±0.02^{a}
Firmness (N)	3.57±0.02^{b}	3.75±0.00^{ab}	3.94±0.00^{ab}	4.19±0.03^{a}	4.22±0.03^{a}
Total phenolic (mg GAE/g)	24.19±0.00^{c}	25.17±0.04^{b}	25.82±0.00^{ab}	26.41±0.01^{a}	26.50±0.04^{a}
Total flavonoid (µg RE/g)	15.20±0.02^{c}	15.97±0.02^{bc}	16.78±0.03^{b}	17.40±0.04^{a}	17.46±0.01^{a}
Sensory score	7.42±0.00^{b}	7.91±0.05^{ab}	8.14±0.02^{ab}	8.43±0.02^{a}	8.50±0.00^{a}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

The effect of CA storage on quality of shallot bulbs was examined. After harvest and after storage weight loss were determined, as well as dry matter, firmness and soluble solids content. The highest differences were observed in firmness; however, storage conditions did not affect bulb's firmness significantly. The highest weight loss was observed in normal atmosphere condition.

Dry matter increased significantly during storage only in 5% CO_2+5% O_2 atmosphere composition. Soluble solids content decreased, although not significantly during storage [14]. One study determined changes in the content of flavonoids in fleshy scales of shallot bulbs in relation to different compositions of atmosphere during storage. Also antioxidant activity of the bulbs was determined. Flavonoid compounds showed the increasing tendency, however not all changes were significant. There was no significant influence of storage conditions on DPPH level, while FRAP level was influenced significantly [13].

Conclusion

Shallot is one of the vegetables, which are especially abounding in flavonoids, phenolic acids and other compounds with anti-oxidative properties. Increased production is accompanied by increase in postharvest losses due to their perishable nature. Due to the relatively short postharvest life in fresh form, shallot should be preserved by effective method. Plastic food packaging causes serious environmental problems. We have successfully found out the usage of friendly edible coating. The application of this coating film may increase shallot producer's income and it could gradually replace traditional, environmentally irresponsible plastic packaging.

References

1. Ernesto Fattorusso, Maria Iorizzi, Virginia Lanzotti, Orazio Taglialatela-Scafati (2002) Chemical composition of shallot (Allium ascalonicum Hort.). J. Agric. Food Chem., 50(20): 5686-5690.
2. Mansour Amin, Sepideh Segatoleslami, Mohammad Hashemzadeh (2009) Antimycobacterial activity of partial purified extract of Allium ascalonicum. Jundishapur J. Microbiol., 2(4):144-147.
3. Mansour Amin, Asie Varnaseri Mohammadi, Mohsen Heidary, Saeed Khoshnood (2018) Antibacterial and anticancer activity of a bioflavonoid fractionated from Allium ascalonicum. Journal of Paramedical Sciences, 9(3): 1-8.
4. Temitope O Lawal, Christopher O Igbokwe, Bolanle A Adeniyi (2014) Antimicrobial activities and the bactericidal kinetics of Allium ascalonicum Linn. (Whole plant) against standard and clinical strains of Helicobacter pylori: Support for ethnomedical use. Journal of Natural Sciences Research, 4(8): 48-56.
5. Igbokwe CO, Lawal TO, Olorunnipa TA, Adeniyi BA, Mahady GB (2014) Antimicrobial susceptibility of crude extracts of Allium ascalonicum Linn. (Whole plant) and Gladiolus psittacinus hook (corm) against five common pathogens: an in vitro investigation. International Journal of Microbiology Research, 6(1): 510-514.
6. Vetriselvi Pandurangan, Safreen Shaikh Dawood Amanulla, Kumaresan Ramanathan (2016) Anti-cancer efficacy of dry and fresh Allium ascalonicum (shallot) against HepG2 cell line. National Journal of Physiology, Pharmacy and Pharmacology, 6(3): 196-199.
7. Zahra Rezaei, Maryam Tajali Ardakani, Reza Mahmoudi (2014) The effect of Cytotoxicity aqueous and alcoholic extract of shallot (Allium ascalonicum) on cancer cells derived from the SD rat on induced-DMBA breast tumor. Bulletin of Environment, Pharmacology and Life Sciences, 3(12): 68-71.
8. Jungeun Cho, Ro-Na Bae, Seung-Koo Lee (2010) Current research status of postharvest technology of onion (Allium cepa L.).Korean Journal of Horticultural Science and Technology, 28(3): 1-7.
9. Nguyen Phuoc Minh (2019) Technical Factors Affecting to pickle shallot (Allium ascalonicum) fermentation. Journal of Pharmaceutical Sciences and Research, 11(3): 879-881.
10. Ji-Yuan Liang, An-Chi Hsu, Xin-Yu Lan, Kuan-Yu Chen, Po-Shuan Chen, Wei-Ming Chou, Kuei-Yan Liou, Dung-Yu Peng, Jeu-

Ming P Yuann (2012) The preparation of preserved shallot powders and a pilot study of the antioxidative effect of their aqueous extracts on the formation of hydroxyl radical species. Open Journal of Applied Sciences, 2: 209-215.

11. Gemma Chope, Leon A Terry, Philip J White (2010) Effect of controlled atmosphere storage on abscisic acid concentration and other biochemical attributes of onion bulbs. Postharvest Biology and Technology, 39: 233-242.
12. M Tendaj, B Mysiak (2010) Contents of certain chemical components in shallot bulbs after harvest and long-term storage. Acta scientiarum Polonorum. Hortorum Cultus, 9(2): 75-83.
13. Marta Pudzianowska, M Gajewski (2012) The effect of CA storage on quality parameters of shallot (Allium ascalonicum L.) bulbs. Acta horticulturae, 934: 1335-1340.
14. Marta Pudzianowska, Marek Gajewski, Jarosław L. Przybył, Agnieszka Buraczyńska, Olga Gaczkowska, Marta Matuszczak, Marta Dziechciarska (2012) Influence of storage conditions on flavonoids content and antioxidant activity of selected shallot (Allium cepa var. Ascalonicum backer) hybrid cultivars. Vegetable Crops Research Bulletin, 77: 101-111.
15. Mohamad Djali, Selly Harnesa Putri (2013) The characteristic change of shallot (Allium ascalonicum L.) during curing process. International Journal on Advanced Science Engineering Information Technology, 3(2): 61-65.
16. Poorva Sharma VP Shehin, Navpreet Kaur Pratibha Vyas (2019) Application of edible coatings on fresh and minimally processed vegetables: a review. International Journal of Vegetable Science, 25(3):295-314.
17. Raheleh Ghasemzadeh, Ahmad Karbassi, Hamid Bahador Ghoddousi (2008) Application of edible coating for improvement of quality and shelf-life of raisins. World Applied Sciences Journal, 3 (1): 82-87.
18. Gladys Rozo, Dolly Gómez, Claudia Rozo (2016) Effect of an alginate edible film coating in the conservation of welsh onion (Allium fistulosum L.). Vitae, 23: 419-423.
19. Meda A, Lamien CE, Romito M, Millogo J, Nacoulma OG (2005) Determination of the total phenolic, flavonoid and praline contents in Burkina Fasan honey, as well as their radical scavenging activity. Food Chemistry, 91(3): 571-577.
20. Quettier-Deleu C, Gressier B, Vasseur J, Dine T, Brunet C, Luyckx M (2000) Phenolic compounds and antioxidant activities of buckwheat (Fagopyrum sculentum Moench) hulls and flour. Journal of Ethno pharmacology, 72: 35-42.
21. Wissam Zam (2019) Effect of alginate and chitosan edible coating enriched with olive leaves extract on the shelf life of sweet cherries (Prunus avium L.). Journal of Food Quality, 8192964: 7
22. V Hershko, A Nussinovitch (1998) Physical properties of alginate-coated onion (Allium cepa) skin. Food Hydrocolloids, 12(2): 195-202.
23. F Varasteh, K Arzani, M Barzegar, Z Zamani (2017) Pomegranate (Punica granatum L.) fruit storability improvement using pre-storage chitosan coating technique. Journal of Agricultural Science and Technology, 19(2): 389-400.

