

Storage Stability of Chilled Minimally Processed Shredded Cabbage

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Introduction

The availability of certain foods and the consumer's purchasing power has changed the patterns of food consumption. Today, the emphasis has changed from ensuring an adequate supply of calories and nutrients to an increased emphasis on quality and convenience. This is due to the upgraded living standard and also a great expansion in the food service industries. Thus, the change in lifestyle has increased the demand of convenience and fresh (or fresh-like) products, which led to a relatively new area of food preservation, that is, minimally processed foods. By definition, minimally processing (MP) would encompass any procedure, short of the traditional complete preservation procedures (heat sterilization, freezing, etc.), that add value. Chilled minimally processed vegetables are vegetables that are washed, cut, peeled, sliced, diced, chopped, shredded followed by low temperature storage to prolong quality retention. Minimally processed vegetables that are now being produced include packaged shredded cabbage, lettuce, carrot, cut chilies, capsicum, peeled and sliced potatoes, sweet potatoes, etc. The shelf-life extension of these fresh cut vegetables is therefore relevant because of its economic impact. Packaging can be one of the important factors in determining the storage stability and quality of these fresh-cut vegetables. The shelf-life of these minimally processed vegetables is often limited by enzymatic browning, loss in texture (firmness) and moisture content. Whilst their organoleptic properties are strongly altered by the appearance of brown pigments. This study was conducted to determine the optimum minimally processing and storage conditions for shelf-life extension of shredded cabbage.

Materials and Methods

Freshly picked round white cabbage (*Brassica oleracea* L. Capitata) of hybrid KKY-Cross was purchased from MARDITECH Plantation in Cameron Highlands. A study was conducted to determine the effects of using different types of polymeric films (Polypropylene (PP), Low density Polyethylene (LDPE), High density Polyethylene (HDPE) and polyvinyl chloride (PVC) cling wrap (Control)) of varying permeabilities to gases and water vapour and also with and without the application of vacuum packaging on the physico-chemical, biochemical, microbiological characteristics and sensory aspects of the minimally processed (MP) shredded cabbage during storage at $5 \pm 1^\circ\text{C}$; 90-95%RH. Studies on the effects of dipping into 4 different anti-browning solutions namely 1% ascorbic acid, 0.1% sodium metabisulfite, 0.5% L-cysteine + 0.1% citric acid and 0.1% acetic acid on the storage stability of shredded cabbage were also carried out. Sample dipped in distilled water was used as a control. Changes in physico-chemical characteristics were determined by quantitative measurements of weight loss, colour, texture, ascorbic acid content, pH, titratable acidity, total soluble solid, chlorophyll content, polyphenoloxidase (PPO) activity and degree of browning. Carbon dioxide and ethylene production in the package atmosphere during storage were also determined with gas chromatography. The microbial characteristics determined were mesophilic and psychrotrophic bacterial mold and yeast counts. Sensory evaluation involved subjective acceptability and descriptive analyses. Data collected were analyzed using ANOVA and Duncan Multiple Range test (DMRT) at 5% significant level.

Results and Discussion

Generally, in almost all the analyses done, the quality of the chilled minimally processed shredded cabbage deteriorated with increase in storage time. Among all the packaging films used, it was found that polypropylene which is the least permeable film for gases and water vapour, could extend the shelf life of the minimally processed shredded cabbage almost up to 3 weeks when stored at $5 \pm 1^\circ\text{C}$; 90-95% relative humidity with minimum colour change, reduction in ascorbic acid content and deterioration in sensory properties and marginally low changes in other parameters tested. Whilst polyvinyl chloride cling wrap (control) was found to be the least effective packaging film. Different packaging systems did not affect the microflora of the shredded cabbage which was predominantly bacteria, small numbers of yeasts and only an occasional mold for both mesophilic and psychrotrophic microorganisms. Sample packed in vacuum packaging showed no significant difference with those in non-vacuum packaging in almost all the parameters tested for all the different packaging films, even though the air from the package headspace which can cause oxidation spoilage to the produce had been removed. Anti-browning treatment of 0.1% sodium metabisulfite gave the best sensory properties and visual colour retention followed by 0.1% acetic acid solution. However, 0.5% L-cysteine + 0.1% citric acid and 1% ascorbic acid solutions were found not to be a very good anti-browning agents for chilled minimally processed shredded cabbage as they gave worse results as compared to the control samples.

Conclusions

Results obtained in the present study, showed that chilled minimally processed shredded cabbage packed in polypropylene bags of 0.03 mm thickness with permeability characteristics of; Water vapour transmission rate = 5.89 g/m²/day; Oxygen transmission rate = >2,000 cc/m²/day; Carbon dioxide transmission rate = 11,931 cc/m²/day, could be stored in good and acceptable condition for a period of almost 3 weeks at 5 ± 1°C ; 90-95% relative humidity with a minimum 0.14% physiological loss in weight, minimum loss in other physico-chemical and biochemical characteristics as well as sensory attributes and staying microbially safe. Meanwhile shredded cabbage in control film (polyvinyl chloride cling wrap) suffered a severe loss of quality after a few days in a similar storage environment. Chilled minimally processed shredded cabbage treated with anti-browning solution containing 0.1% sodium metabisulphite gave the best anti - browning effects in terms of retaining colour and other sensory qualities followed by 0.1% acetic acid solution. Whereas, 1% ascorbic acid and the combination of 0.5% L-cysteine + 0.1% citric acid were found not to be good anti-browning solutions for minimally processed shredded cabbage.

Benefits from the study

Minimally processing generally increases the rates of metabolic processes that caused deterioration of fresh produce. The physical damage or wounding caused by preparation increases respiration and ethylene production and other biochemical reactions responsible for changes in colour (browning), flavour, texture and nutritional quality. The greater the degree of processing, the greater would be the wounding response. Results obtained in this study indicate that chilled minimally processed shredded cabbage packed in polypropylene film could be stored in good and acceptable condition for almost 3 weeks. Chilled minimally processed cabbage treated with 0.1% sodium metabisulphite was effective in retaining colour and other sensory qualities followed by 0.1% acetic acid solution. These findings will benefit the expanding production of minimally processed vegetables, in particular, cabbage, for fresh consumption (production of coleslaw and vegetables salads) in the food service industries and the various fast food outlets in Malaysia.

Patent(s), if applicable:

Nil

Stage of Commercialization, if applicable:

Nil-

Project Publications in Refereed Journals:

Nil

Project Publications in Conference Proceedings

- Osman, A., Saari, N., Abdul Rahman, R. and Ibrahim, R. (2001). Effect of different packaging films on the physico-chemical characteristics of minimally processed shredded cabbage stored at chilled temperature. In: Proceeding of the Malaysian Science and Technology Congress 2001; p 734-742.
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Graduate Research

Name of Graduate	Research Topic	Field of Expertise	Degree Awarded	Graduation Year
Roshita Ibrahim	Storage Stability of Chilled Minimally Processed Shredded Cabbage	Postharvest Technology	MSc.	2003

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