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Effect of Packaging on Keeping Quality of Fresh Ginseng

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수삼의 저장성에 미치는 포장의 영향

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Abstract

Fresh ginseng was packed by using available commercial plastic films of polyvinyl chloride (PVC), cast polypropylene (CPP) and low density polyethylene (LDPE). PVC was used as a wrapping on polystyrene tray, and CPP and LDPE were applied as pouch packages. Gas composition of the package and keeping quality of ginseng in the packages were evaluated for 20 day storage at 5℃. LDPE (27㎛ thick) package modified the package atmosphere to 11.7% O_2 and 2.1% CO_2, gave low microbial growth and good sensory score after 20 day storage.

Key words : fresh ginseng, packaging, modified atmosphere

Introduction

In the orient, ginseng has been recognized as a medicine for thousands of years in preserving the health and longevity. Ginseng is also realized as a health food and consumed for such purpose. Most of ginseng has been processed into dried form of white ginseng or red ginseng for storage and marketing. White ginseng is obtained by peeling and drying raw ginseng of four year age or over, while red ginseng is made by steaming and drying ginseng of six year age [1]. In resent years, there are growing interest and demand for fresh ginseng from consumers. Fresh ginseng is used in food service establishment and home for many kinds of menus. New types of cooking menus containing fresh ginseng are being introduced for restaurants and home by chefs. These days it is easy to find the fresh ginseng in supermarket. Demand for fresh ginseng is expected to increase further in future.

However, fresh ginseng has shorter shelf life compared with dried one. Packaging is one of methods to be used for extending shelf life of fresh produce [2]. Packaging modifies the atmosphere inside the package interacting with produce respiration, which can help keeping quality of fresh ginseng. Even though fresh ginseng is being marketed widely and has a potential to get benefits from packaging, information for packaging fresh ginseng is very limited in the literature. Lee and Kim [3] reported that controlled atmospheres (O_2 3-6%, CO_2 3-6%) reduce respiration and weight loss. There is no available

data regarding optimal modified atmosphere for quality retention, and it is hard to find effects of packaging on keeping quality of fresh ginseng.

This work aims to look into the effect of packaging on the keeping quality of fresh ginseng as a way to find the conditions of extending shelf life.

Materials & Methods

Sample Preparation

Fresh ginseng (four years old) was purchased from a local market in Masan City, Korea. The fresh ginseng was washed and allowed to drain at room temperature for 30 minutes in order to remove excess surface water. The fresh ginseng was then rubbed with a paper kitchen towel to remove residual surface water.

Packaging

About 130 g of fresh ginseng was packed by using available packaging films, which are polyvinyl chloride (PVC), cast polypropylene (CPP) and low density polyethylene(LDPE). PVC was applied as stretch wrapping on polystyrene tray of 20×15cm. CPP and LDPE were used as pouch type packages of 20×15cm. The size of package is for normal retail. Oxygen and carbon dioxide permeabilities measured by quasi-isostatic method [4] are presented in Table 1. All the packages were stored at 5℃ and relative humidity of 90% for 20 days.

Table 1. O_2 and CO_2 permeabilities of packaging films at 5℃.

Film	Thickness (μm)	Gas permeability(ml μm/m^{2}hr atm)		Manufacturer
		O_2	CO_2	
PVC	13.7	3262	17151	Lucky Co.
CPP	30	825	2113	S. T. C
LDPE	27	2264	11462	Daekyung Ind.

Measurement of Ginseng Quality

After 20 day storage, package atmosphere and keeping quality were measured for 5 replicate packages. Gas composition inside package was analyzed using a Hewlett Packard 5890A gas chromatography equipped with a thermal conductivity detector and an Alltech CTR I column(Alltech Associates, Inc., USA).

As quality indices of stored ginseng, weight loss, sugar content, microbial count and organoleptic appearance (color) were measured. Sugar content was determined as soluble solid in Brix by refractometer (Atago Co., Japan). Saponin content was determined by the method of Sung et al. [5]. For microbial count of fresh ginseng one root within each package was weighed and immersed in 100ml sterile water. The solution was serially diluted with sterile water and 0.05ml of 10^{-3} diluted solution was spread on MEA plate (malt extract 5%, dextrose 2%, agar 2%). Plates were incubated for 24 hours at 37℃. After counting with diluted sample solution, microbial counts were expressed as $\log_{10}$ count per g sample. Organoleptic evaluation of appearance and color was performed on 7 trained panel members by 5 point hedonic scaling. Point 5 was excellent and Point 1 was extremely poor. Differences between treatments were determined by Duncan's multiple range test.

Results & Discussion

Modified Atmosphere inside Package

Gas compositions inside the packages are presented in Table 2. Tray type package wrapped with PVC film showed the atmosphere close to that of air because stretch wrapping with PVC film without heat sealing caused some air leakage through contact surface of the package. This type phenomenon has been reported for PVC wrapped package of green chili pepper by Lee et al.[6]. CPP package showed lowest O_2 and highest CO_2(4.9% O_2 and 6.2 % CO_2) among all three packages, which was close to controlled atmospheres tried by Lee and Kim (1979). This is due to relatively low permeability of CPP. LDPE gave relatively high O_2 concentration and low CO_2 buildup in the package. For fresh ginseng optimum modifeid atmosphere is not known or reported, therefore it would be helpful to look into the effect of modified atmosphere on the quality of ginseng. We examined further the relationship between package atmosphere and keeping quality of fresh ginseng.

Table 2. Modified atmosphere inside packages of 130 g fresh ginseng.

Package conditions			Package atmosphere	
Packaging film[a]	Package type	Dimension (cm×cm)	O_2 (%)	CO_2 (%)
PVC(13.7)	Tray	20×15	19.7±0.7	1.0±0.5
CPP(30)	Pouch	20×15	4.9±1.8	6.2±0.1
LDPE(27)	Pouch	20×15	11.7±0.6	2.1±0.1

[a] Number in parenthesis is thickness in μm.

Effect of Packaging on Keeping Quality of Fresh Ginseng

Weight losses of fresh ginseng inside the package after 20 days storage are presented in Table 3. Package wrapped with PVC film incurred much higher weight loss(10.3%) than the other pouch type packages. Generally most fruits and vegetables are known to lose their freshness when the water loss reaches 3-10% of their initial weight [7]. When assessed by the same guideline PVC packages passed shelf life limit at 20 day storage. Weak package integrity of PVC wrapping should have resulted in high weight loss, while only slight weight losses were occurred in CPP and LDPE packages.

As shown in Tables 4 and 5, sugar and saponin content of fresh ginseng after 20 day storage were highest for PVC package. However, it should be noted that high sugar and saponin content came from concentration effect due to great weight loss and do not mean good freshness keeping. CPP package showed the same sugar content and a little higher saponin retention compared with LDPE package.

For microbial count LDPE package showed lowest microbial proliferation at 20 day storage (Table 6). It is hard to find the clear correlation between modified atmosphere and microbial count. High CO_2 and low O_2 concentration is generally known to reduce microbial growth [8]. However, on contrary CPP package having highest CO_2 and lowest O_2 concentration showed highest microbial count. The atmosphere should have been not low enought in O_2 or high enough in CO_2 to control microbial growth [9]. Humidity might have determined the microbial growth on ginseng. Therefore adequate humidity attained from relatively highly permeable LDPE is thought to get low microbial count [10]. For CPP

package too high humidity with water condensation seems to favor microbial growth [7, 11]. High microbial count of PVC package could be caused by little modified atmosphere.

Highest sensory score of appearance and color was given for 20 days stored fresh ginseng in LDPE package (Table 7). PVC package showed the worst sensory score because of high weight loss (Table 3). It is interesting that LDPE package retained best ginseng in viewpoint of organoleptic quality, even though the package showed a little wrose saponin retention than CPP package. Low microbial growth from adequate water permeability of LDPE might have enhanced sensory quality of ginseng. There is another possibility that CO_2 concentration of 6.2% in CPP package might have invoked some kind of physiological injury to fresh ginseng. Many vegetables have CO_2 tolerance limit less than or equal to 5 %, and little is known about fresh ginseng [12]. For controlled or modified packaging of fresh ginseng, further work concerning the effect of reduced O_2 and elevated CO_2 concentration on ginseng quality is needed.

Table 3. Weight loss of fresh ginseng in the package after 20 day storage.

Packaging	Weight loss(%)	
Film	Initial	After 20 days
PVC	0	10.3±0.7
CPP	0	0.4±0.1
LDPE	0	0.7±0.1

Table 4. Change in sugar content for fresh ginseng in the package after 20 day storage.

Packaging	Sugar content (Brix)	
Film	Initial	After 20 days
PVC	18.2±1.3	18.4±0.8
CPP	18.2±1.3	17.0±0.9
LDPE	18.2±1.3	17.0±0.7

Table 5. Change of saponin content of fresh ginseng in the package after 20 day storage.

Packaging	Saponin content (%)	
Film	Initial	After 20 days
PVC	0.98±0.2	0.92±0.2
CPP	0.98±0.2	0.80±0.2
LDPE	0.98±0.2	0.74±0.2

Table 6. Microbial count on fresh ginseng in the package after 20 day storage.

Packaging	Microbial count (log(cfu*/g))	
Film	Initial	After 20 days
PVC	4.5±0.1	6.3±0.0
CPP	4.5±0.1	6.5±0.0
LDPE	4.5±0.1	5.7±0.0

* cfu means colony forming unit.

Table 7. Organoleptic appearance and color of fresh ginseng in the package after 20 day storage. (A 5 point hedonic scaling was used)

Packaging	Average sensory score*	
Film	Initial	After 20 days
PVC	5	1.9[c]
CPP	5	3.4[b]
LDPE	5	4.3[a]

* Panel were trained to give 5 point for initial samples. Different superscript means the significant difference at 99% confidence level for the same storage time (Duncan's multiple range test).

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초 록

시중에서 이용가능한 플라스틱 필름을 이용하여 수삼을 포장하고 포장이 수삼의 저장성에 미치는 영향을 살펴보았다. 실험에 사용한 필름으로는 폴리비닐클로라이드(PVC), 폴리프로필렌(CPP), 저밀도폴리에틸렌(LDPE) 이었으며, PVC는 폴리스티렌 트레이에 스트렛치랩포장으로 사용하였고, 다른 필름은 파우치 포장으로 실험에 사용하였다. 130g의 수삼을 포장하여 5℃에서 저장하면서 20일후의 품질변화를 측정한 결과 27㎛두께의 LDPE필름을 사용한 포장이 포장내의 가스조성을 11.7% O_2, 2.1 % CO_2로 얻을 수 있었고 낮은 미생물 성장과 좋은 관능적인 품질을 얻을 수 있었다.

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