PACKAGING AND STORAGE OF MINIMAL PROCESSED GARLIC
(AUILLUM SATIVUM L)

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ABSTRACT

The effect of different types of packaging material and storage condition on the quality of minimal processed garlic was studied. Two varieties of garlic i.e., PG 01 and PG-117 commonly grown in Punjab were packed in different polymeric films with common thickness of 37.5 μm viz. high density polyethylene (HDPE), low density polyethylene (LDPE), polypropylene (PP) and in a plastic tray as a control. Samples were stored at ambient and refrigerated conditions. Changes in moisture content and color occurred linearly in all the packaging materials. The minimum change in moisture content and color of peeled cloves was observed in LDPE for both the varieties and storage condition. It has been concluded that out of the two varieties PG-01 has longer storage life than the latter. Garlic cloves could be stored in LDPE film for 5 days at room temperature and more than 15 days at refrigerated conditions. Statistical analysis showed that storage period, storage condition and packaging material have a significant effect at 5% level of significance on the moisture content and color of the samples; whereas variety has a non significant effect on the quality parameters.

Key words: Garlic, Packaging, Storage, Moisture colour.

INTRODUCTION

Garlic (Allium sativum) is a member of the Amaryllid family (Amaryllidaceae), which also includes leeks, onions, and shallots. It has an underground bulb (head) composed of pungent bulblets commonly called cloves. Garlic is an important spice crop of our country. It is grown in rabi season and produce reaches the market from March to May. Garlic has been used worldwide since ancient times for its beneficial medical properties and as a flavoring agent and spice (Rivlin 2001). Garlic therapy has been suggested in flatulence, constipation, faulty indigestion, inadequate food intake, chronic coughs, leprosy and in many other diseases. Garlic has been extensively used in several preparations like chutney, pickles, curry powder, cooked vegetables, tomato ketchup, meat preparations etc. Garlic bulbs harvested in the summer are often stored at room temperature. The quality of these bulbs usually deteriorates after six months of harvest, but constant supply of garlic is required throughout the year to fulfill the demand. As freshly harvested garlic is available in the market for three to four months, a huge quantity of garlic is to be stored to fulfill the demand of the consumers (Pandey and Bhonde, 1997). Considerably high portion of the stored garlic is lost due to various kinds of losses (Anonymous., 2002; Mihalescu et al., 1979). The major storage losses in garlic are physiological weight loss (12 to 15%), soft rot (10 to 25%) and black mould infection (1 to 5%) (Maini and Chakravati, 2000). Several factors such as varietal characteristics, cultural practices, pre- and post-harvest treatment and storage environment influence the storability of garlic ([Bartos and Rod, 1985; Bib et al., 2008; Dong et al., 2000; El-Shabrawy et al., 1987). The type of storage environment and packing material significantly influence the storage losses in garlic (Gayle et al., 2004; Hadenburg, 1986; Hughes, 2005; Rosen, 2001). Peeled garlic cloves are minimally processed vegetable and its volumes have increased in retail and food service markets due to its extensive utility as medicinal and domestic purposes (Cantwell and
Statistical analysis: Data were interpreted by analysis of variance with the general linear model procedure using SAS software package (SAS, Ver 9.2, SAS Institute Inc., Cary, NC). All the experimentation was carried out in triplicate, the effect of the main factors and their two way and three way interactions on various attributes has been evaluated.

RESULTS AND DISCUSSION

The moisture content at the time of storage for PG-01 was 88% and PG-117 was 87.7%. Change in moisture content occurred linearly in all the packaging materials in both the varieties (Fig. 1). During first five days of storage, moisture content was steady in all the packaging materials except for the control sample at the ambient condition. The change in moisture was least in LDPE film in both the varieties for both the storage condition with change most pronounced in control samples. Similar trend was observed by Sagar and Kumar, 2009; Tripathy et al., 2009. Statistical analysis showed that significant differences were observed in moisture content for the different packaging materials \(p=0.0001\), the storage duration \(p=0.0001\), storage condition \(p=0.0001\), and variety \(p=0.0001\), after 15 days of storage of peeled cloves at 95% confidence level which indicated that variability in the packaging films was largely responsible for this type of behavior (Table1). All interactions between different variables like materials, storage period, storage condition and variety also significantly affected independently \(p=0.0001\). However, the two way interactions between these parameters showed that the interaction between parameters have significant effect \(p=0.0001\) except for variety with storage \(p=0.5481\) and packaging \(p=0.0414\).

In garlic, out of the three color values \(L\) value is of maximum significance as it indicates the whiteness or blackness. The effect of packaging material on the color of peeled cloves is shown in Figure 2. Change in \(L\) value was minimum in LDPE at both the storage conditions followed by HDPE and PP packs and most pronounced in control samples. The change in color was greater at ambient conditions than that of refrigerated storage conditions (\(L\) value remained almost constant) as the effect of light was lesser in refrigerated storage.
FIG. 1. Moisture contents of peeled garlic cloves

FIG. 2. L value of peeled garlic cloves
<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Sum of Square</th>
<th>Mean Square</th>
<th>F Value</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture Change in color</td>
<td>Moisture Change in color</td>
<td>Moisture Change in color</td>
<td>Moisture Change in color</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variety (V)</td>
<td>1</td>
<td>8.114</td>
<td>8.409</td>
<td>8.114</td>
<td>8.409</td>
</tr>
<tr>
<td>Storage condition (SC)</td>
<td>1</td>
<td>15.809</td>
<td>89.615</td>
<td>15.809</td>
<td>89.615</td>
</tr>
<tr>
<td>Storage period (SP)</td>
<td>7</td>
<td>188.988</td>
<td>945.804</td>
<td>26.998</td>
<td>135.115</td>
</tr>
<tr>
<td>Packaging (P)</td>
<td>3</td>
<td>58.760</td>
<td>145.140</td>
<td>19.586</td>
<td>48.380</td>
</tr>
<tr>
<td>V x SC</td>
<td>1</td>
<td>0.035</td>
<td>1.549</td>
<td>0.034</td>
<td>1.549</td>
</tr>
<tr>
<td>V x SP</td>
<td>7</td>
<td>0.695</td>
<td>1.473</td>
<td>0.099</td>
<td>0.210</td>
</tr>
<tr>
<td>V x P</td>
<td>3</td>
<td>0.815</td>
<td>4.172</td>
<td>0.272</td>
<td>1.390</td>
</tr>
<tr>
<td>SC x SP</td>
<td>7</td>
<td>6.381</td>
<td>65.536</td>
<td>0.912</td>
<td>9.362</td>
</tr>
<tr>
<td>SC x P</td>
<td>3</td>
<td>8.533</td>
<td>6.126</td>
<td>2.844</td>
<td>2.042</td>
</tr>
<tr>
<td>SP x P</td>
<td>21</td>
<td>22.360</td>
<td>39.508</td>
<td>1.065</td>
<td>1.881</td>
</tr>
</tbody>
</table>

FIG. 3: Overall change in color (ΔE) value of peeled garlic cloves
The analysis of variance revealed significant effects of the packaging materials (p=0.0001), storage duration (p=0.0001), PG-01 storage condition (p=0.0001), and variety (p=0.0001) on overall change in color of cloves. The interactions between the parameters showed that all the interaction have significant affect (p=0.0001) except for variety with storage period (p=0.6261) storage condition (p=0.0210) and packaging (p=0.0033).

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