The Assessment of Plastic Materials for Monitoring the Moisture, Colour, Pungency and Rancidity of ‘Chili Boh’

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Key words: ‘Chili Boh’; Capsicum annum; packaging; processing; storage.

ABSTRACT


INTRODUCTION

‘Chili Boh’ is a thick slurry of chilli (Capsicum spp.) of which the dried form of Capsicum annum is the most popular raw material. This item made its first appearance in the Malaysian consumer market as recently as in the early 1980's. Its popularity is gaining steadily, despite the existing availability of its counter part, chili powder. This probably is due to its more convenient easy-to-use form which is taken advantage of by food caterers, small business food dwellers and finally the new generation of working and non-working wives. Though it is bulkier to handle than the powder form, consumer acceptance is always the ultimatum that dictates
the market potential of an item. Thus the potential of this new chili product should therefore not be belittled.

The quality of the Capsicum spp. is assessed on the basis of its colour, pungency, aroma and flavour. The pungency is due to capscicum (8-methyl-N-Vanillyl-6-noheamide, C\textsubscript{18}H\textsubscript{27}O\textsubscript{5}\textsubscript{N}) content which varies from 0.01 to 1.0 percent (Nelson and Dawson, 1923; Rowland et al., 1983; Kosuge and Furuta, 1969 and Masada et al., 1971). It can be affected by fat oxidation since it is soluble in fat. The pungency and colour of chillies are also affected by drying and storage (Lease and Lease, 1962). The colour which is due to its carotenoids is also degraded by the fat oxidation (Chen and Gutmanis, 1968; Kanner et al., 1977 and Budowski and Bondi, 1960).

The deterioration in the quality of 'Chili Boh' can be slowed down by the use of appropriate packaging materials for handling and distribution purposes. Presently, the mode of packaging and the materials used is not efficient in maintaining the quality of the product. Therefore, the objective of this paper is (1) to study the protection offered by the four selected packaging materials in maintaining the pungency, colour and flavour of the packaged 'Chili Boh' and, (2) to identify the limiting factors in the shelf-life of the product.

MATERIALS AND METHODS

Sample Preparation

Dried chili (Capsicum annum) was purchased from a local market. Stalks and other debris were removed. It was then washed and soaked in hot water (about 100°C) in the ratio of 15:100 for 10 minutes. After blending at 35 r.p.m. for 5 minutes in a food processor (TOSHIBA, Model TFP 1200) or until a homogeneous slurry was obtained, sodium benzoate (0.1% w/w) and acetic acid (0.4% w/w) were added. The slurry (80 g aliquots) was then individually packed and heat sealed in polypropylene (PP), polypropylene/cellophane/polyethylene (PP/CPP/PE), oriented polypropylene/polyethylene (OPP/PE) and low density polyethylene (LDPE) and stored at room temperature (30°C, R.H. ± 82.86%). LDPE packaged samples were used as controls. The packages were of 10 cm × 10 cm size.

Methods of Analysis

The water vapour permeabilities of plastics used was assessed using a control Relative Humidity Chamber (Blue M Electrical Com., 1971). 50 g of silica gel was weighed together with the pouches (10 cm × 10 cm) and put in the chamber at 38°C, and relative humidity of 90% to equilibrate. Changes in the weight of samples were recorded at an interval of 24 hours for 120 hours. The water vapour permeabilities was calculated as g/cm\textsuperscript{2}/24 hours.

The oxygen permeability of plastics was assessed using gas permeability tester (Zwick 6201/1). The tested plastic materials were clamped by a spherical clamp between two vertical gas chambers. Oxygen was passed into the upper chamber until the pressure in the chamber reached 1 atmospheric pressure. The diffusion of oxygen into the lower chamber was read off from a liquid indicator. The oxygen permeability of the plastic materials was recorded as cm\textsuperscript{3}/m\textsuperscript{2}/24 hours at 1 atmospheric pressure.

Proximate analysis of moisture, ash and fat content of 'Chili Boh' was carried out by the A.O.A.C. procedure (A.O.A.C., 1975).

The thiobarbituric acid value (TBA) was determined by the method of Tarladgis et al., (1960). Optical densities were read at 538 nm using UNICAM spectrophotometer (Model SP8-150 UV/Vis).

The extractable colour and the degree of pungency was measured according to the method of Leslie and Fisher (1971).

Statistical Analysis

Analysis of variance was used for all data obtained. Further analysis of significance was carried out using Tukey's test (Snedecor, 1956).
RESULTS AND DISCUSSION

Low density polyethylene (LDPE) had the highest permeability to both oxygen and water vapour. While PP/CPP/PE was found to have the lowest oxygen and water vapour permeability. OPP/PE had a permeability approximately the same as that of PP/CPP/PE (Table 1). This is in accordance with the current knowledge that the addition of plain cellophane does not have a greater advantage over the water vapour permeability of the material but offers an additional gas barrier to O₂, N₂ and CO₂.

Results from the proximate analysis indicate that ‘Chili Boh’ had approximately 7.8% crude fat, 93.4% moisture and 6.9% ash. Proximate analysis of marketed ‘Chili Boh’ showed that samples contained on the average 8.4% crude fat, 87.0% moisture and 5.7% ash. The crude fat content of the prepared samples was slightly lower because no fillers such as papaya, sweet potato or starch was used. The higher ash and moisture content of samples compared to the marketed samples were also due to the absence of the filler. In this experiment the filler was not added because there was such a varied percentage and types of fillers being used. The high crude fat content coupled with high moisture content made the product potentially liable to rancidity. The possible propagation of bacteria, yeasts and molds in such a high moisture content environment was counteracted by the addition of sodium benzoate and acetic acid in the formulation of the studied samples.

Since the sorption isotherm of ‘Chili Boh’ was not carried out in this experiment, the change of moisture content of the packaged samples is therefore important as a reflection of its characteristic relative to moisture i.e. whether it has a tendency to lose or gain moisture from the environment under the storage condition studies. Results obtained showed no significant change of moisture content but a slight loss (approximately an average of 2%) was observed during storage up to 6 weeks in all packaging materials used.

Thiobarbituric acid values of packaged ‘Chili Boh’ during storage are shown in Figure 1.

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**TABLE 1**

<table>
<thead>
<tr>
<th>Plastic</th>
<th>Thickness (mm)</th>
<th>Water vapour (g/m²/24 hours at 38°C)</th>
<th>Oxygen Permeabilities (cm³/m²/24 hours at latm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polypropylene (PP)</td>
<td>0.10</td>
<td>3.20</td>
<td>700</td>
</tr>
<tr>
<td>Polypropylene/cellophane/polyethylene (PP/OPP/PE) (0.02/0.02/0.03 mm)</td>
<td>0.07</td>
<td>1.30</td>
<td>4</td>
</tr>
<tr>
<td>Oriented polypropylene/polyethylene (OPP/PE) (0.02/0.05 mm)</td>
<td>0.07</td>
<td>1.58</td>
<td>6</td>
</tr>
<tr>
<td>Low density polyethylene (LDPE) (CONTROL)</td>
<td>0.10</td>
<td>17.83</td>
<td>2792</td>
</tr>
</tbody>
</table>

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Fig. 1. TBA values of packaged ‘Chili Boh’ during storage.

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Table 2
A.S.T.A. Units* of packaged 'Chili Boh' during storage

<table>
<thead>
<tr>
<th>Time (weeks)</th>
<th>Plastic materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>PP/CPP/PE</td>
</tr>
<tr>
<td></td>
<td>OPP/PE</td>
</tr>
<tr>
<td></td>
<td>LDPE</td>
</tr>
<tr>
<td>0</td>
<td>9.63</td>
</tr>
<tr>
<td>1</td>
<td>9.53</td>
</tr>
<tr>
<td>2</td>
<td>9.12</td>
</tr>
<tr>
<td>3</td>
<td>9.04</td>
</tr>
<tr>
<td>4</td>
<td>8.12</td>
</tr>
<tr>
<td>5</td>
<td>6.63</td>
</tr>
<tr>
<td>6*</td>
<td>6.29</td>
</tr>
</tbody>
</table>

*Any two values not followed by the same subscript are significantly different (P < 0.05).

All samples packaged in LDPE and PP were already rancid in the 4th week of storage. 'Chili Boh' packaged in OPP/PE had not undergone complete oxidation even up to the 6th week of storage though PP/CPP/PE packaged samples reached the oxidation peak at the 5th week of storage. The rancidity of the packaged sample as an index of suitability of the studied packaging material in extending the shelf-life of 'Chili Boh' is fundamental. Philip et al., (1971) noted that the capsicum family is rich in the unsaturated linoleic acid which can undergo oxidation. The oxygen permeability of the packaging materials influences in part the rate of rancidity as measured by the peak amount of malondialdehyde produced. An inversely proportional relationship of packaging material oxygen permeability to maximum amount of malondialdehyde produced was obtained.

The colour changes of samples packaged in LDPE and PP started as early as the first week of storage. Significant changes of colour in these samples were observed in every consecutive week. Samples packaged in PP/CPP/PE and OPP/PE started showing significant colour changes only after the second week. Kanner et al., (1977) suggested that the colour stability of capsicum spp. powder decreased with increasing moisture content when the relative moisture exceeded 14% water activity (a, 0.64). However, in this study, it was observed that oxygen availability as reflected by the respective permeabilities of the packaging materials affected the colour deterioration of samples. Moisture did not have any significant effect as noted in the earlier discussion.

The pungency characteristics of 'Chili Boh' as measured by the Scoville values are as shown in Table 3. Products packaged in PP/CPP/PE and OPP/PE had a significant change of pungency only after their 4th week of storage. The pungency or the heat associated with the capsicums is very important in its application as a flavouring agent. Therefore, its loss as early as two weeks of storage cannot be tolerated from the manufacturers point of view.

Conclusion

Colour, flavour and pungency are the main characteristics of 'Chili Boh' that change during storage. In this study, colour was found to be the limiting factor in the shelf-life of the product. The pungency and the flavour (related to the degree of rancidity) in packaged 'Chili Boh' is relatively stable up to six weeks. Based on cost compatibility of product and package, OPP/PE is thus recommended for this product though PP/CPP/LDPE is equally acceptable.
ASSESSMENT OF PLASTIC MATERIALS FOR MONITORING THE CHARACTERISTICS OF 'CHILI BOH'

TABLE 3
Sooville values* for packaged 'Chili Boh' during storage

<table>
<thead>
<tr>
<th>Time (weeks)</th>
<th>PP</th>
<th>PP/CPP/PE</th>
<th>Plastic materials</th>
<th>OPP/PE</th>
<th>LDPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11600&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11600&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11600&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11600&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>11400&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11500&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11400&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11400&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>11100&lt;sup&gt;b&lt;/sup&gt;</td>
<td>11300&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>11300&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>11000&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
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<tr>
<td>6</td>
<td>10800&lt;sup&gt;b&lt;/sup&gt;</td>
<td>11100&lt;sup&gt;b&lt;/sup&gt;</td>
<td>11000&lt;sup&gt;b&lt;/sup&gt;</td>
<td>10500&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

*Any two values not followed by the same subscript are significantly different (P < 0.05)

REFERENCE


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