Effect of clove on the bacterial quality and shelf life of chicken meat

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Abstract

The inhibitory effect of clove essential oil on the bacterial quality of minced chicken meat was assessed up to eight days of refrigerated storage at 4±1°C. Minced chicken meat was treated with essential oil of clove (one per cent). The inhibitory effect of clove was evaluated during storage by comparing with the control batch. The biopreservative completely inhibited Escherichia coli group of bacteria while reducing coliforms to a significant level. The spice essential oil was also effective in increasing the shelf life of minced meat to six days when stored at 4±1°C, while control samples showed signs of spoilage from fourth day onwards. The study proves the efficacy of clove oils in reducing the bacterial load in meat, while extending the shelf life at refrigeration.

Keywords: Escherichia coli, clove, chicken meat, shelf-life.

Introduction

Meat and meat products play an important role in human diet by providing a large variety of micro and macronutrients. Poultry meat is accepted worldwide and its consumption has grown considerably from less than half a kilogram per person in 1990 to 2.2 kg per annum per person in 2013 (FAO, 2013). Meat being a highly perishable commodity undergoes spoilage from the time of slaughter till consumption. There has been increasing consumer concern about the presence of food borne pathogens and their effect on shelf life of the products (Kumudavally et al, 2005). Adverse health effects of chemical preservatives have led to the decreased preference of chemically treated food stuffs. Currently, food scientists are focusing their interests in discovering new natural antimicrobials and preservatives (Dhanze et al., 2013). Spices like clove, generally used in Indian culinary to provide distinctive flavour to the foods, have also been reported to exhibit inhibitory effect on many food borne pathogens (Sunil, 2006; Kumudavally et al., 2005; Smith-Palmer et al., 1998). The inhibitory effect of spices on microbes is due to the presence of essential oils in them, which contain components like Eugenol (Sharma and Verma, 2006). In the present investigation, the effect of essential oil of clove in inhibiting the bacterial spoilage and extending shelf life of chicken meat stored at 4±1°C was evaluated.

Materials and Method

A total of six batches of fresh broiler meat (six weeks old birds) were purchased from a local sales centre. Each batch consisted of one kilogram of cleaned chicken meat packed in clean and dry polyethylene bag. From each batch, chicken meat was deboned and minced well before subjecting to clove treatment and subsequent storage. Clove treatment was done by mixing the minced chicken with essential oil of clove (one per cent) diluted at a rate of 1 in 50 with absolute alcohol. The control group consisted of minced chicken without any treatment. A total of five different portions (100g) of control and clove treated samples were packed in sterile polyethylene bags and stored under refrigeration at 4±1°C. These portions were taken for microbiological analyses on 0, 2, 4, 6 and 8 days of study. At each day of analyses, 25g sample was homogenized with 225 ml sterile peptone water (0.1 per cent) to form one in 10 dilution of the sample. Further 10 fold serial dilutions were prepared by transferring one milliliter to nine milliliter of the diluent. Dilutions were made up to 10^{-3} and selected dilutions of each sample were used for the estimation of various microbial loads per milliliter of sample. The samples were analyzed for estimation of Total Viable Count (Morton, 2001), Coliform Count (Kornacki and Johnson, 2001) and Escherichia coli Count (Bureau of Indian standards, 1980) and also for isolation of Escherichia coli (Bureau of Indian standards, 1980).
Table 1: Microbial counts of control and clove treated samples

<table>
<thead>
<tr>
<th>Treatment group</th>
<th>Days of storage</th>
<th>Total Viable Count (log_{10} cfu/ml)</th>
<th>Coliform Count (log_{10} cfu/ml)</th>
<th>E. coli Count (log_{10} cfu/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.19 ± 0.02</td>
<td>2.90 ± 0.02</td>
<td>3.15 ± 0.03</td>
<td>4.43 ± 0.07</td>
</tr>
<tr>
<td>Clove treated</td>
<td>1.48 ± 0.06</td>
<td>2.43 ± 0.07</td>
<td>2.77 ± 0.05</td>
<td>3.74 ± 0.06</td>
</tr>
<tr>
<td>Control</td>
<td>1.22 ± 0.08</td>
<td>1.56 ± 0.12</td>
<td>1.73 ± 0.13</td>
<td>2.24 ± 0.06</td>
</tr>
<tr>
<td>Clove treated</td>
<td>0.13 ± 0.08</td>
<td>0.21 ± 0.05</td>
<td>0.29 ± 0.13</td>
<td>0.33 ± 0.33</td>
</tr>
<tr>
<td>Control</td>
<td>0.10 ± 0.02</td>
<td>0.35 ± 0.02</td>
<td>0.98 ± 0.03</td>
<td>1.02 ± 0.07</td>
</tr>
<tr>
<td>Clove treated</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
</tbody>
</table>

Figures bearing same superscripts between columns of the same row do not differ significantly. N= 12 samples on each day of storage.

Result and Discussion

The microbial count of raw chicken meat (control) and clove treated chicken during storage for eight days is shown in Table 1. The analysis of control samples showed that the count on day zero was at a level of two log and a highly significant (p<0.01) increase was seen in the counts till the end of storage period. However, in clove treated samples, the count on day zero was at a level of one log and the count was only significantly (p<0.05) different from the count on day two and four. The count on day six and eight differed highly significantly (p<0.01) from the count on day zero. Yadav et al. (2002) reported a decrease in mesophilic counts in minced chicken meat treated with clove extract at 0.15 per cent level and stored at refrigeration temperature. The analysis of the counts of control and clove treated samples using t test revealed a highly significant (p<0.01) reduction in counts in clove treated samples throughout the storage period. Naveena et al. (2006) had reported that buffalo steaks dipped in clove oil had significant (P<0.05) reduction in aerobic plate counts and coliform counts.

The mean coliform count in control samples on day zero and two differed highly significantly (p<0.01) from the counts on day four, six and eight whereas in clove treated samples the count on day zero did not differ significantly (p>0.05) except on day eight. Comparison of the counts of control and clove treated samples revealed a highly significant (p<0.01) reduction in counts of clove treated samples on all days of storage except on eighth day, indicating reduction in the activity of the clove oil. The Escherichia coli count of control and clove treated samples were analyzed using paired t-test and is shown in Table 1. The mean count in control samples on day zero and two differed significantly (p<0.05) from the counts on day four, six and eight, whereas, in clove treated samples the counts on all days were zero. Comparison of the counts of control and clove treated samples revealed a cent per cent reduction in counts of clove treated samples on all days of storage (Table 1) indicating high antibacterial activity of the clove oil against Escherichia coli. Sunil (2006) had reported an extended shelf life in buffalo meat mince treated with clove essential oil stored at refrigeration temperature as compared to control samples.

The isolation of Escherichia coli and Salmonella was attempted from control and clove treated samples. Control samples yielded three E. coli isolates while none of the treated samples yielded positive organisms. Salmonella could not be detected in both control and clove treated samples. Escherichia coli isolates were identified as organisms belonging to serotypes O166 and O65 (2). The presence of Escherichia coli is of great public health significance since the organisms are responsible for a variety of illness from mild diarrhea to severe hemorrhagic colitis.

Conclusion

The analysis of data obtained for the two batches clearly show the effectiveness of clove oil in reducing microbial growth. Clove essential oil treatment was highly effective against coliforms and Escherichia coli as indicated by the results. Signs of spoilage started in control samples even from fourth day onwards while the treated samples did not show any signs of spoilage till the end of sixth day of storage.
refrigerated storage. Hence the treated samples had a greater shelf life than the control samples indicating the efficacy of clove in prolonging the shelf life. The study proved the usefulness of clove oil in increasing the shelf life of chicken meat and meat products stored under refrigeration.

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**References**


