EFFECT OF PAPAIN ON TENDERIZATION AND FUNCTIONAL PROPERTIES OF SPENT HEN MEAT CUTS

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ABSTRACT

Spent hen leg cuts were treated with different concentrations of papain (0, 0.025, 0.05, 0.075 and 0.1 %) at 3 and 5 % levels (w/w) to improve the tenderness of meat. Papain with 0.025 % concentration and at 3 % level produced significantly \((P<0.05)\) more tender meat than control (0%) group. The above selected concentration and level were tried using both the multiple injection and the infusion plus forking technique in breast cuts. It was observed that papain at the above said concentration and level using infusion plus forking technique could significantly \((P<0.05)\) increase the pH, salt soluble protein, water holding capacity (WHC), emulsifying capacity and emulsion stability irrespective of cuts with lower values in leg as compared to breast cuts except the pH which was higher in leg cuts.

INTRODUCTION

Raw material plays an important role in agro-based industries and poultry and poultry products are no exception to it. The increase in poultry meat production in India from 1991 to 1999 was 66.97 per cent, which was much lower than the per cent increase in world poultry meat production (52.95%) during the same period (FAO, 1991 and FAO, 2000). In the process, culled hen which were being used for meat purpose are going to be discarded by the quality conscious consumers due to inherent quality differences especially tenderness between broiler and spent hen meat (Sachdev and Verma, 1990). Therefore, the farmers are facing a problem to dispose off their layers at the end of their productive laying cycle at a distressed price.

The well recognized methods of tenderization, like ageing and electrical stimulation, have their own limitations for exploitation in the industrial sector (Sinha and Panda, 1985). It has been reported that different tenderizing agents such as enzymes, chlorides, phosphates etc. have been used successfully to tenderize aged and tough meat (Sachdev and Verma, 1990). Under the circumstances, use of papain might be helpful in solving the problem to some extent as USDA and other regulating agents have allowed the use of proteolytic enzymes in meat products. Therefore, an attempt was made to study the effect of papain on tenderness and other functional properties of spent hen meat cuts.

MATERIAL AND METHODS

Forty ‘White leghorn’ spent hen of about 18 months old were used for each of the three trials. The birds were dressed as per the procedure described by Sahoo and Panda (1983), leg and breast cuts were made from each bird. In order to avoid variation in anatomical cuts, only right leg cuts were injected with 3 and 5 per cent (W/W) of papain at different level of concentration (0.025, 0.05, 0.075 and 0.1 %) at 1 cm intervals to ensure uniformity. Left leg cuts were acted as control (0%). The samples were weighed before and after multiple injection and then held at 4±10°C for 12 hours to allow the enzyme to equilibrate and subjected to evaluate their shear press value (Bouton et al., 1977) by using Warner-Bratzler Shear Press. The selected level of papain, based upon tenderness, was used in breast cuts to study the effect of different application technique (injection and infusion plus forking) for tenderness. Using the selected techniques, concentration and level both the leg and breast cuts were treated with papain.

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for further evaluation of its effect on total and salt soluble protein (Hudspeth and May, 1967), WHC and emulsifying capacity (Whiting and Jenkins, 1981), emulsion stability (Saffle et al., 1967) and pH (Bouton et al., 1971). The data were subjected to statistical analysis using randomized block design and the differences between treatment means were calculated by new Duncan’s multiple range test (Steel and Torrie, 1981; Snedecor and Cochran, 1994).

RESULTS AND DISCUSSION

Results in Table 1 indicated that the tenderizing effect was increased in leg cut with the increase in concentration of enzyme used. This was in line with earlier findings made by Huang (1990). Since, the lowest concentration used in the experiment 0.025 per cent could bring about significant difference (P<0.05) in tenderness between the control and treated group, it was considered to stick to this level. Moreover, higher doses of papain might give rise to allergic reactions in some consumers (Reed, 1975). Considering this in view, the 0.025 per cent concentration with 3 per cent level was selected as no significant difference (P>0.05) was observed in tenderness between 3 per cent and 5 per cent levels.

It is clear from the results indicated in Table 2 that infusion plus forking technique is quite comparable statistically to multiple injection technique, though both the techniques were found significantly (P<0.05) better than the control ones. These findings are consistent with the observations of Mier et al. (1962). Since infusion plus forking technique is quite easy to adopt and does not need any expensive machineries or added skill when compared with multiple injection technique, it may have more commercial acceptance.

The findings also indicated (Table 3) that the breast cut contained significantly (P<0.05) more of total and salt soluble protein than the leg cuts in control samples. Hudspeth and May (1967) also reported similar findings. Between control and papain treated cuts (leg and breast), a significant (P<0.05) difference was observed with regard to per cent extractable protein and per cent salt soluble protein. This was in agreement with the findings of Huang (1990).

When comparison was made between both the cuts in control group regarding pH (Table 4), it was observed that the pH of leg cuts was higher than the breast cuts. Application of papain significantly (P<0.05) increased the pH of both the cuts. The WHC was significantly (P<0.05) lower in leg cuts when compared to breast cuts in the control group, though the pH of he former tissue was more. Since, meat tissue with high pH has been shown to have better WHC by Ngoka et al. (1982), however as per report by Mendiratta and Panda (1992) pH is not only the sole factor responsible for WHC.

There was a significant (P<0.05) difference in the WHC between control and papain treated leg and breast cuts. Perhaps this was due to increased hydrophilic property of papain treated muscle tissue. Sinha and Panda (1985) have also reported increase in hydrophilic property of poultry meat due to papain treatment.

It was observed that the emulsifying property of breast cut was better than the leg cuts in the control group. Perhaps this was due to higher per centage of salt soluble protein in these cuts. Rurka and May (1968) also indicated salt soluble proteins are more efficient as emulsifiers of oil. Between the treatment and control ones, there occurred a significant (P<0.05) improvement in the emulsifying capacity irrespective of the cuts. This was in agreement with the findings of Huang (1990).

Emulsion stability was found to be lower in leg cut when compared to breast cut of the control group. The emulsion stability was significantly (P<0.05) improved in both the enzyme treated cuts. This was perhaps due to increase in the concentration of proteins as Chen and Tseng (1979) have already reported...
Table 1. Effect of various concentrations of papain injection on shear force value of spent hen leg cuts

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Concentration of papain</th>
<th>Shear force values (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3% level</td>
<td>5% level</td>
</tr>
<tr>
<td>Control</td>
<td>0 %</td>
<td>2.47±0.037</td>
</tr>
<tr>
<td>Experimental</td>
<td>0.1%</td>
<td>0.90±0.016</td>
</tr>
<tr>
<td>Experimental</td>
<td>0.075%</td>
<td>1.14±0.025</td>
</tr>
<tr>
<td>Experimental</td>
<td>0.05%</td>
<td>1.42±0.022</td>
</tr>
<tr>
<td>Experimental</td>
<td>0.025%</td>
<td>1.74±0.033</td>
</tr>
</tbody>
</table>

Figures with different superscripts in a column are significantly different at P<0.05.

Table 2. Effect of multiple injection and infusion plus forking technique on tenderization of spent hen breast cuts

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Shear force values (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>2.90±0.115</td>
</tr>
<tr>
<td>Injection</td>
<td>1.45±0.006</td>
</tr>
<tr>
<td>Infusion plus forking</td>
<td>1.46±0.044</td>
</tr>
</tbody>
</table>

Values with different superscripts in a column are significantly different at P<0.05.

Table 3. Effect of papain treatment on the total and salt soluble protein content of leg and breast cuts

<table>
<thead>
<tr>
<th>Cuts</th>
<th>% Total protein (Control/Experimental)</th>
<th>% Salt soluble protein (Control/Experimental)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leg</td>
<td>22.44±0.096/23.04±0.120</td>
<td>31.00±0.076/32.07±0.023</td>
</tr>
<tr>
<td>Breast</td>
<td>26.20±0.163/26.61±0.212</td>
<td>43.50±0.171/46.77±0.033</td>
</tr>
</tbody>
</table>

Values with different superscripts in a row with small letters and in column with capital letters are significantly different at P<0.05.

Table 4. Functional properties of raw and treated meat due to papain (0.025%) treatment

<table>
<thead>
<tr>
<th>Cuts</th>
<th>WHC (ml/100 g) (Control/Experimental)</th>
<th>Emulsifying capacity (ml oil/2.5 g) (Control/Experimental)</th>
<th>Emulsion stability (% Separation of fat and liquid)</th>
<th>pH (Control/Experimental)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leg</td>
<td>7.82±0.159/8.45±0.187</td>
<td>123.30±0.101/130.68±0.159</td>
<td>8.37±0.045/8.68±0.090</td>
<td>6.06±0.058/6.34±0.058</td>
</tr>
<tr>
<td>Breast</td>
<td>11.67±0.058/12.54±0.067</td>
<td>132.75±0.140/140.09±0.124</td>
<td>6.42±0.109/6.17±0.047</td>
<td>5.89±0.013/6.12±0.014</td>
</tr>
</tbody>
</table>

Values with different superscripts in a row with small letters and column with capital letters for each characteristic are significantly different at P<0.05.

that emulsion stability increases with the increase in concentration of protein.

The study suggests that papain with 0.025 per cent concentration at 3 per cent level (w/w) adopting infusion plus forking technique can be used to improve the tenderness and functional properties of spent hen meat cuts for their efficient utilization.

REFERENCES