EFFECT OF DIFFERENT TENDERIZERS ON TENDERNESS AND QUALITY OF BUFFALO TRIPE

M. Anna Anandh
Regional Research Centre,
Tamil Nadu Veterinary and Animal Sciences University, Pudukkottai – 622 004, India
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ABSTRACT

A study was conducted to standardize the method for tenderization of buffalo tripe with ginger extract (GE), papain, and sodium bi carbonate (SB) in conjunction with blade tenderization (BT). Buffalo tripe after passing three times through mechanical blade tenderizer (BT-3x) was treated with 0.05% papain, 5% GE, 2.5% SB with two controls. Tripe pieces were marinated for 4 hours and evaluated for physico-chemical and organoleptic qualities. The results showed that buffalo tripe treated with 0.05% papain, 5% GE, 2.5% SB and BT-3x significantly better for all physico-chemical properties as compared to control. The sensory scores were significantly higher for 0.05% papain treated buffalo tripe sample except flavour which was higher in 5.0% GE treated samples.

Key words: Blade tenderization, Buffalo tripe, Ginger extract, Papain, Quality, Sensory attributes, Sodium bi carbonate, Tenderness.

INTRODUCTION

India is endowed with the largest buffalo population in the world. Buffaloes are slaughtered mainly for meat, the byproducts from slaughtered animals are also of good value. Buffalo tripe is one of the important edible offal and weighs about 4.36 to 5.45 kg per animal. Commercial exploitation of tripe for development of processed product manufacture is very limited because of its poor functional properties and inherent toughness due to high collagen content. It is essential to develop technologies for utilization of tripe into processed product manufacture by reducing its toughness. Proteolytic enzymes such as papain, bromelin and ficin have been used for many years to tenderize tough cuts of meat. The best tenderization effects are achieved with papain. Papain is the thiol protease which develops its optimum activity in the pH range of 6.0 – 7.5 (Pawar et al. 2003). Papain is very powerful in hydrolyzing fibrous protein and connective tissue and reported that papain solubilised 15% connective tissue proteins and 60% salt soluble proteins. Ginger extract is widely used as a condiment in household cooking. Wang et al. (1991) reported that sodium bicarbonate decreased the cooking loss and improved tenderness of culled beef when it was used as tenderizer. In general, uniform penetration of tenderizer enzyme has always posed problem during tenderization treatment. Blade tenderization (BT) is one of the most effective mechanical methods. It tenderizes the meat to certain extent and open up the structure of meat to facilitate uniform penetration of tenderizer. Hence, a study was undertaken for tenderization of buffalo tripe by using papain, ginger extract (GE) and sodium bi carbonate (SB) in conjunction with mechanical blade tenderization.

MATERIALS AND METHODS

Buffalo tripe: Buffalo tripe was obtained from local buffalo offal market. The fat and adhering extraneous materials were removed tripe pieces of less than 2 cm in size were cut and they were deodorized by using 5% trisodium phosphate solution for 30 minutes (Anna Anandh et al. 2004). The time lag between slaughter of animal and commencement of experiment was about 3 hours.

Ginger extract (GE): Fresh ginger was purchased from local market. The ginger was peeled, sliced, ground in a mortar with pestle and squeezed through...
two layer of cheese cloth to produce a crude ginger extract. The yield of crude extract was approximately 50% of the peeled ginger. For 5.0% GE treatment, 5 ml of ginger extract was dissolved in 5 ml distilled water and the mixture was sprayed on 100 g of meat chunks.

**Papain**: Readily available papain enzyme powder procured from a standard firm (HiMedia, Mumbai) was used in this study. For 0.05% papain treatment, 0.05 gm of papain powder was dissolved in 10 ml distilled water and the mixture was sprayed on each 100 g of meat chunks.

**Sodium bicarbonate (SB)**: Sodium bi carbonate used was of analytical grade and procured from standard firms (SD Fine Chemicals). For 2.0% sodium bi carbonate treatment, 2.0 g of SB was dissolved in 10 ml distilled water and the mixture was sprayed on every 100 g of meat chunks.

**Tenderization method**: The deodorized buffalo tripe chunks were subjected to three times blade tenderization (BT 3x) using Hobart blade type mechanical blade tenderizer. The buffalo tripe pieces were further tenderized with concentration of papain 0.05% (treatment I), ginger extract 5.0% (treatment II) and SB 2.5% (treatment III). The required concentration of papain, ginger extract and sodium bi carbonate were dissolved with distilled water (10 ml) and sprayed on 100 g of tripe pieces. For controls (control I - no treatment and control II - 3 times blade tenderization) only 10 ml of distilled water was used. After thorough mixing by hand, the tripe pieces were packed in polyethylene bag and kept at 4 ± 2°C for 12 hours. After 12 hours of treatment, the samples were analyzed for various physico-chemical parameters and sensory attributes.

**Physico-chemical characteristics**: pH of the samples was determined by using digital pH meter. Water holding capacity (WHC) was measured by the procedure reported by Wardlaw et al. (1973). Cooking loss (CL) was calculated from weights taken before and after cooking of tripe samples at 80 ± 2°C for 25 minutes and expressed as a percentage. The shear force value (SFV) was assessed by using Warner-Bratzler shear press. Fragmentation index (FI) value was determined by the procedure outlined by Davis et al. (1980). Collagen content and collagen solubility of tripe samples were determined by the method described by Mahendrakar et al. (1989).

**Sensory evaluation**: The controls and treated tripe samples were enrobed with batter consisting of curd (53%), common salt (11%), condiments mix – onion + garlic 3:1 (22%), spice mix (11%), sodium tri polyphosphate (3%) and nitrite (0.015%) @ 18% w/w. Smooth and even coating of batter was ensured. After 4 hours holding, the tripe pieces were cooked in electric tandoor oven for 45 minutes to an internal temperature of 80 ± 2°C. Experienced sensory panel members evaluated the products for appearance, flavour, juiciness, tenderness and overall palatability on a 8-point descriptive scale.

**Statistical analysis**: All experiments were repeated four times and the data generated from each trial were analyzed by following standard procedure described by Snedecor and Cochran (1989) for comparing the means and to determine the effect of treatments.

**RESULTS AND DISCUSSION**

**Physico-chemical and sensory characteristics**

The pH value of 0.05% papain and SB

![Table 1](image_url)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control</th>
<th>BT - 3x</th>
<th>BT - 3x + 5% Ginger extract</th>
<th>BT - 3x + 0.05% Papain</th>
<th>BT - 3x + 2.5% Sodium bicarbonate</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.25 ± 0.07a</td>
<td>7.40 ± 0.06a</td>
<td>7.53 ± 0.04a</td>
<td>7.58 ± 0.07b</td>
<td>8.09 ± 0.24c</td>
</tr>
<tr>
<td>Water holding capacity (%)</td>
<td>32.09 ± 1.73b</td>
<td>35.24 ± 1.29b</td>
<td>39.41 ± 1.13b</td>
<td>39.76 ± 0.61b</td>
<td>44.85 ± 1.69c</td>
</tr>
<tr>
<td>Cooking loss (%)</td>
<td>31.57 ± 1.94a</td>
<td>35.13 ± 1.84a</td>
<td>40.34 ± 1.66b</td>
<td>46.59 ± 1.77c</td>
<td>34.83 ± 2.07d</td>
</tr>
<tr>
<td>Shear force value (kg/cm²)</td>
<td>4.32 ± 0.20a</td>
<td>3.69 ± 0.15b</td>
<td>3.52 ± 0.04a</td>
<td>2.49 ± 0.04a</td>
<td>3.30 ± 0.23a</td>
</tr>
<tr>
<td>Fragmentation Index (%)</td>
<td>810.25 ± 2.81a</td>
<td>800.00 ± 3.48a</td>
<td>799.50 ± 2.53b</td>
<td>734.00 ± 7.50b</td>
<td>752.00 ± 1.47c</td>
</tr>
<tr>
<td>Collagen content (%)</td>
<td>2.23 ± 0.14a</td>
<td>2.29 ± 0.15b</td>
<td>2.39 ± 0.12a</td>
<td>3.20 ± 0.29b</td>
<td>2.97 ± 0.28b</td>
</tr>
<tr>
<td>Collagen Solubility (%)</td>
<td>10.90 ± 2.00a</td>
<td>13.34 ± 1.97a</td>
<td>17.49 ± 2.57b</td>
<td>26.12 ± 6.25c</td>
<td>17.67 ± 4.01b</td>
</tr>
</tbody>
</table>

*aNumber of observations = 4.

Means bearing same superscripts row-wise do not differ significantly (P<0.01).
treated sample was significantly higher as compared to 5.0% GE, BT-3x and control (Table 1). pH value of papain and SB treated sample differ significantly but pH value between 5.0% GE, BT-3x and control did not differ significantly from each other. Increase in the pH of treated samples might be due to combined effect of BT and treatment. A small increase in pH due to BT was also reported by Pietrasik and Shand (2004). Higher pH values of ginger extract treated products might be due to higher pH of ginger extract. Higher pH values of sodium bicarbonate treated products might be due to alkaline nature of sodium bicarbonate (Mendiratta et al. 2004). Sen et al. (2003) reported that 3% sodium bicarbonate increased pH up to 7.99. Sheard and Tali (2004) reported that sodium bicarbonate increased the pH of cooked pork loin. The present findings were in conformity with above results.

There was a significant (P < 0.01) increase in WHC values observed for all treated samples as compared to control and BT 3x sample. However, WHC values for 5.0% GE and 0.05% papain treated samples did not differ significantly between them but differ significantly from 2.5% SB treated sample. The WHC values between control and BT 3x treated sample also did not differ significantly. Tyszkievicz et al. (1997) reported that the main factor causing elevation of WHC of meat was mechanical disruption of contractile structure integrity and it may inferred that BT contributed to higher WHC of tripe by increase in pH and mechanical disruption of muscle fibres and protein availability. Thus, increased WHC of GE, papain and SB treated samples might be due to effect of BT and higher pH of treated samples. Mendiratta et al. (2004) also reported increased WHC of GE, papain and SB treated samples might be due to elevated pH.

Increased cooking loss was observed in sample treated with 0.05% papain followed by 5% GE and 2.5% SB treated samples. All treatments differed significantly (P < 0.01) from control I and II. Among treatments, the cooking loss for papain, GE and SB treated samples differed significantly between them. The increased cooking loss value of papain treated samples might be due to combined effect of papain and blade tenderization. Blade tenderization significantly increased cooking loss which might be due to moisture loss through holes made by Blade tenderizer. Papain further decreased cooking loss by extensive degradation of muscle structure due to over tenderization with undesirable mushy texture. Sen et al. (2003) also reported reduced CL values sodium bicarbonate treated in broiler meat as compared to control. Sheard and Tali (2004) reported that SB treatment improved the yield of cooked pork loin. Wang et al. (1991) reported that SB decreased the CL of culled beef when it was used as tenderizer.

All treated samples have significantly lower shear force value as compared to control I and II. Between control I and II the differences was non significant. Among treated sample 0.05% papain treated sample have lower SFVs followed by 5% GE and 2.5%SB treated samples. The treated samples differed significantly between them. Probably both BT and tenderization treatments have contributed to a decrease in SFVs. Thompson et al. (1973) also reported decrease of SFV from 4.27 to 2.80 kg/cm³ by GE treatment in ovine femoris muscle. Reduction in shear force value of beef meat treated with papain was also reported by Takagi et al. (1992). Wang et al. (1991) reported that SB improved the tenderness of culled beef when it was used as tenderizer. SB reduced the SFV (Wynvean et al. 2001), because of improved WHC at elevated pH. Sheard and Tali (2004) also reported that SB treatment increased the pH and thus reduced the SFV by half as compared to control.

Significantly (P< 0.01) lower fragmentation index value was observed for 0.05% papain treated sample followed by 2.5% SB treated sample and both samples differed significantly from each other. However the fragmentation index values for 5.0% GE treated sample, control I and II did not differed significantly between them. Blade tenderization causes decreased fragmentation index by disrupting the muscle structure and papain treatment further resulted in extensive degradation of meat structure leading to undesirable mushy texture.

The mean collagen content values were slightly higher for all papain treated sample and 2.5% SB treated samples as compared to 0.05% ginger extract treated sample, control I and II. The
TABLE 2: Comparative efficacy of blade tenderization and different tenderizers on sensory characteristics of buffalo tripe (Mean ± SE).

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control</th>
<th>BT - 3x</th>
<th>BT - 3x + 5%</th>
<th>BT - 3x + 0.05%</th>
<th>BT - 3x + 0.05%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Ginger extract</td>
<td>Papain 2.5%</td>
<td>Sodium bi carbonate</td>
<td></td>
</tr>
<tr>
<td>Sensory attributes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appearance &amp; colour</td>
<td>5.4 ± 0.11a</td>
<td>6.2 ± 0.05b</td>
<td>6.4 ± 0.04b</td>
<td>6.6 ± 0.08b</td>
<td>6.2 ± 0.03b</td>
</tr>
<tr>
<td>Flavour</td>
<td>5.2 ± 0.17a</td>
<td>6.5 ± 0.10b</td>
<td>6.7 ± 0.09b</td>
<td>6.1 ± 0.04b</td>
<td>6.0 ± 0.14b</td>
</tr>
<tr>
<td>Juiciness</td>
<td>4.8 ± 0.16a</td>
<td>6.2 ± 0.05b</td>
<td>6.3 ± 0.05b</td>
<td>6.7 ± 0.05b</td>
<td>6.1 ± 0.04b</td>
</tr>
<tr>
<td>Tenderness</td>
<td>4.2 ± 0.09a</td>
<td>6.1 ± 0.04b</td>
<td>6.5 ± 0.10b</td>
<td>6.9 ± 0.04b</td>
<td>6.4 ± 0.11b</td>
</tr>
<tr>
<td>Overall acceptability</td>
<td>5.0 ± 0.14a</td>
<td>6.2 ± 0.05b</td>
<td>6.4 ± 0.08b</td>
<td>6.7 ± 0.05c</td>
<td>6.3 ± 0.09d</td>
</tr>
</tbody>
</table>

**Number of observations = 20.**

Sensory attributes were evaluated on a 8 – point descriptive scale (wherein 1 = extremely undesirable; 8 = extremely desirable).

Means bearing same superscripts row- wise do not differ significantly (P< 0.01).

collagen content values between 0.05% papain treated ample and 2.5% SB treated sample and control-I, II and 5.0% ginger extract treated samples did not differed significantly between them. Slightly higher collagen content in papain treated samples might be due to effect of papain on proteolysis of collagen.

The mean collagen solubility values did not differ significantly between 2.5% SB, 5.0 GE treated samples, control-I and II. However, the collagen solubility values of 0.05% papain treated samples differed significantly from other treatments and controls. Collagen solubility values of GE treated samples in our experiment were in agreement with Thompson et al. (1973) who reported significant increase in collagen solubility of ovine muscle with GE treatment. Takagi et al. (1992) reported higher collagen solubility in beef meat treated with papain as compared to water treated control.

**Sensory characteristics:** There was significant (P< 0.01) improvement in appearance scores in all treated products and control-II products as compared to control-I (Table 2). Although, appearance scores for 0.05% papain treated products were higher than control-II, 5.0% GE and 2.5% SB treated products, the difference was non-significant. Significant (P<0.01) improvement was noticed in all treated products and control-II products as compared to control-I. Flavour scores of 5.0% GE treated products were significantly (P<0.01) higher than control-II, 0.05% papain and 2.5% SB treated products. However, flavour scores of BT-3x, 0.05% papain and 2.5% SB treated products did not differ between them. Juiciness scores of control-II and all treated products were significantly (P<0.01) higher than control-I. Juiciness scores for 0.05% papain treated products were slightly higher than other treated products and control-II products. However, juiciness scores of control-II, 5.0% GE and 2.5% SB treated products did not differ significantly among them. Tenderness scores of all treated products and control-II products were significantly (P<0.01) higher than control-I. Tenderness scores for 0.05% papain treated products slightly were higher than 5.0% GE treated products but the scores did not differ significantly between them. Tenderness scores for 2.5% SB and control-II products also did not differ significantly between them. There was significant (P<0.01) improvement in overall acceptability scores for all treated products and control-II products as compared to control-I. Acceptability scores for 0.05% papain treated products were significantly higher than control-II, 5.0% GE and 2.5% SB treated products. However, the overall acceptability scores of control-II, 5.0% GE and 2.5% SB treated products did not differ significantly between them.

The results of sensory attributes of this experiment clearly indicated that all the sensory attributes scores were higher for 0.05% papain treated products, except flavour. Flavour scores were significantly higher for 5% GE than 0.05% papain, whereas overall acceptability scores were significantly higher for 0.05% papain over 5% GE treatment. Therefore, papain at the concentration of 0.05% was selected as the ideal tenderizer for tenderization of buffalo tripe.
CONCLUSION

Based on the results of physico-chemical parameters and sensory attributes, it can be concluded that 0.05% papain appeared more efficient for tenderization of buffalo tripe followed by 5% ginger extract and 2.5% sodium bi carbonate in combination with 3 times blade tenderization (BT-3x).

REFERENCES


