P - 106

# The Effects of the Injection of Proteolytic Enzymes and Ginger Extract into *M. pectoralis profundus* of Beef on Intramuscular Connective Tissue and Myofibrillar Protein

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## Introduction

There are several types of methods for enzymes to penetrate into meat post mortem, such as dipping in solution of proteolytic enzymes, pumping enzyme solution into major blood vessels of meat cut and rehydration of the freeze-dried meat in solution. The former two methods have a problem with resulting in a mushy texture and over-tenderisation on the surface (Lawrie, 1998). The rehydration of the freeze-dried meat is not easy method to be utilised in pilot level due to inconvenience to use its method, even though the method is more effective for distribution of enzymes throughout meat than the others. There is a little literature on the research of using an injection followed by tumbling to determine the effect of proteolytic enzymes as food grade in EU regulation and ginger extract on beef tenderisation. Recently a research (Naveena *et al.*, 2004) was carried out to determine the effect of plant proteases, including cucumis, ginger and papain, sprayed on the surface of buffalo meat on tenderisation.

Therefore, the objective of this study, for effectively use enzymes in meat industry, is to investigate the effect of proteolytic enzymes, which are approved as food grade, and ginger extract by injection method on beef tenderisation associated with breaking down collagen and Waner-Bratzler shear force.

## Materials and Methods

Control used was injected with water into *M. pectoralis profundus* using a Dorit PSM-21

Inject-O-Mat brine injector at 10%, followed by vacuum-tumbling for 10 mins. Bromelain and papain were purchased for food grade in EU regulation (Biocatalysts, UK). Each proteolytic enzyme and ginger extract were treated as followseach treatment was injected with each solution of bromelain, bromelain + papain and ginger extract using the above same injector at 10 % to give a concentration of 50 ppm bromelain, the combination of 50 ppm bromelain and 20 ppm papain, and 5% ginger extract. Excess amount of solution was drained. After injecting the solution, each treatment was vacuum-tumbled for 10 mins and vacuum-packed. The samples treated were allowed to equilibrate in a chill at 0°C for 48 hrs. Each sample taken out of the chill room was given at the same equilibration time, followed by cutting up steaks and held frozen at -20°C until experimentation, but the samples for drip loss were used immediately after equilibration. The measurements were Ph, drip loss, cook loss, collagen contents, DSC and WBSF.

## Results and discussion

There was no difference in pH measured before injection and at 48 hrs after injection between treatments (Table 1). Control was a significantly ($P<0.05$) lower for % cook loss than bromelain, but not different from ginger extract treatment. No significant difference was found in drip loss between any of all treatments and control, but slightly lower values were observed in samples treated with ginger extract and papain, comparable to control. As expected, Total collagen content showed no significant difference between any of all treatments and control. For soluble collagen content, bromelain, bromelain + papain and ginger extract treatments were significantly higher ($P<0.05$) than control. Bromelain treatment had a significantly higher ($P<0.05$) soluble collagen content than ginger extract treatment, but no significant difference was found between ginger extract and bromelain +

**Table 1. The effect of enzyme treatments on pH, cook and drip loss**

| | Control | Bromelain | Bromelain + Papain | Ginger extract | S.E.D | C.V % |
|---|---|---|---|---|---|---|
| pH before injection | 5.69 | 5.68 | 5.66 | 5.64 | 0.03 | 0.8 |
| pH at 48 hrs after in jection | 5.70 | 5.80 | 5.74 | 5.73 | 0.03 | 0.8 |
| △pH increment | 0.01 | 0.12 | 0.08 | 0.09 | | |
| Cook loss % | 33.92$^{b}$ | 39.08$^{a}$ | 37.47$^{ab}$ | 34.50$^{ab}$ | 1.66 | 7.2 |
| Drip loss % | 1.21 | 1.28 | 1.13 | 1.04 | 0.36 | 48.6 |

$^{a, b}$ Different letters in the row indicate signigicant difference. ($p > 0.05$)

Table 2. The effect of enzyme treatments on total, soluble and insoluble collagen contents

| | Control | Bromelain | Bromelain + Papain | Ginger extract | S.E.D | C.V % |
|---|---|---|---|---|---|---|
| Total collagen(mg/g) | 12.2 | 10.8 | 11.6 | 11.2 | 1.07 | 14.7 |
| Soluble collagen(mg/g) | $0.56^{c}$ | $4.15^{a}$ | $2.7^{ab}$ | $1.16^{b}$ | 0.59 | 43.7 |
| Insoluble collagen(mg/g) | $11.60^{a}$ | $6.72^{c}$ | $8.67^{bc}$ | $10.2^{b}$ | 1.01 | 17.2 |
| Collagen solubility(%) | $4.7^{c}$ | $38.7^{a}$ | $23.1^{b}$ | $10.3^{b}$ | 4.98 | 41.0 |

$^{a\sim c}$ Different letters in the row indicate signigicant difference. ($p$> 0.05)

papain treatments. These corresponded with insoluble collagen results for treatments and control, which showed control to be highest ($P$<0.05) as compared to treatments, while bromelain treatment to be lowest ($P$<0.05). The thermograms of control, proteolytic enzyme and ginger extract treatments are shown in Table 3. The endothermic transition of intramuscular connective tissue showed bromelain + papain treatment to have significantly lower ($P$<0.05) onset temperature than control, although no significant difference was found between it and the other treatments. Enzyme and ginger extract treatments had a significantly lower ($P$<0.05) melting temperature than control, but there was no difference between treatments. A significant difference was observed in WBSF between enzyme treatments and control, although there was not significantly different between treatments (Table 3). The decrease rate of WBSF based on control was 36, 40 and 37 % for bromelain, bromelain + papain and ginger extract treatments, respectively.

Table 3. The effect of enzyme treatments on thermal transition temperature of intramuscular connective tissue and WBSF

| | Control | Bromelain | Bromelain + Papain | Ginger extract | S.E.D | C.V % |
|---|---|---|---|---|---|---|
| Onset temperature | $61.07^{a}$ | $59.0^{ab}$ | $58.28^{b}$ | $59.29^{ab}$ | 0.89 | 2.4 |
| Melting temperature | $65.5^{a}$ | $63.43^{b}$ | $63.55^{b}$ | $63.37^{b}$ | 0.03 | 0.8 |
| WBSF(N) | $64.0^{a}$ | $40.9^{b}$ | $38.5^{b}$ | $40.6^{b}$ | 7.04 | 24.7 |

$^{a, b}$ Different letters in the row indicate signigicant difference. ($p$> 0.05)

## Implications

Proteolytic enzymes and ginger extract were effective on tenderising *M. pectoralis profundus*, resulting in higher collagen solubility, a decrease of melting denaturation temperature and WBSF compared with the control. Comparing all treatments, bromelain treatment showed to be higher for collagen solubility than other treatments, but no significant differences in onset and melting denaturation temperature of intramuscular connective tissue were found. These corresponded to WBSF results. The present study indicates that ginger extract might be effectively able to be utilised in pilot level as better alternatives to bromelain and papain for tenderisation of tough meat, such as cull cow and beef cuts with many collagen.

## References

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