Journal of Research in Ecology
An International Scientific Research Journal
ISSN No: Print: 2319 –1546; Online: 2319– 1554

Original Research

Physical changes of spent hen meat tenderized with different levels of bromelain enzyme

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ABSTRACT:

This study was conducted to determine the effect of bromelain enzyme tenderization on the physical parameters of spent hen meat from October 2017 to December 2017 at agriculture college laboratory-Al-Muthanna University. 45 spent hen (ISA brown) were used for the experiment and meat was taken from the main cut of carcass (breast, thigh and drumstick). Solutions were formulated with different concentrations of bromelain enzyme (0.05%, 0.1%, 0.15%) for the treatments (T_5, T_4, T_3), respectively. Other samples were submerged in the negative control treatment of distilled water (T_1) and positive control of 1% vinegar (T_2). This study compared the effect of different solutions on physical traits of spent hen. The bromelain enzyme was purchased from Maple Life sciences company of India. The results of the experiment have shown a significant decrease (P<0.05) on the physical properties (water holding capacity, drip loss, thawing loss). Significant decrease (P<0.05) was seen in the shear force values in all samples submerged in bromelain enzyme solution compared with the controls treatments.

Keywords:

Bromelain, Spent hen, Tenderization, Physical traits.

Article Citation:
Saad KJ Al-Waeli, Jassim K Al-Gharawi and Hussain M Al-Dhalimi
Physical changes of spent hen meat tenderized with different levels of bromelain enzyme
Journal of Research in Ecology (2018) 6(1): 1647-1652

Dates:
Received: 19 April 2018 **Accepted:** 16 May 2018 **Published:** 31 May 2018

Web Address:
http://ecologyresearch.info/documents/EC0564.pdf

INTRODUCTION

Chicken meat is an important food sources in the world, because great for its importance. It contains various necessary human nutrients (Ristic *et al.*, 2006). The hens are intended to produce table eggs mostly the meat wasn't used in nutrition. Therefore, large numbers of hen haven't been utilized at the end of egg production period. Poor quality and hardness of its meat are the reasons for low consumer demand (Souza *et al.*, 2011). Increasing the hen, becomes very difficult to sell spent hen at reasonable prices (Kondaiah, 1993). Several studies have been conducted to improve the spent hen meat quality, improvement of meat tenderness using enzymes (Naveena and Mendiratta, 2004), salts and phosphates (Tan *et al.*, 2018), calcium chloride (Gerelt *et al.*, 2000). Enzymes from plant, bacterial and fungal sources were used as meat tenderizers (Minh *et al.*, 2012). One of these plant enzymes is bromelain enzyme, extracted from the trunks of pineapple fruit, widely used as a meat tenderizer (Ketnawa and Rawdkuen, 2011). It is important to dissolve collagen in the sarcolemma membranes due to its ability to analyze myosin protein in the mayoviral components (Kolle *et al.*, 2004). This enzyme accelerates the fragmentation of muscle fibroids, disassembles tissue structure of the connective tissue in the muscle meat and protein. It can be supplemented as a pharmaceutical or dietary product using bromelain stem (Hale *et al.*, 2005). The present study aims to tenderize of spent hen meat with different levels of bromelain enzyme and its effect on physical characteristics.

MATERIALS AND METHODS

Forty-five ISA brown spent hen were used in this experiment. All hens aged 84 weeks and 2100g average weight. Spent hen carcass were randomly distributed to five experimental treatments, the treatments were as follows:

- First treatment (T_1 meat exposed to distilled water).
- Second treatment (meat exposed to 1% vinegar solution).
- Third treatment (meat exposed to 0.05% bromelain solution).
- Fourth treatment (meat exposed to 0.10% bromelain solution).
- Fifth treatment (meat exposed to 0.15% bromelain solution).

The tests were conducted in the laboratories at the University of Al-Muthanna, Agriculture College from October 2017 until December 2017. Before slaughtering the birds were fasted for 12h. They were slaughtered according to the Islamic way followed in Iraq in the slaughter of chickens. After scalding and cleaning, the meat were packaged in polyethylene vacuum bags and stored in the refrigerator at 5°C for 24h. Carcasses were cut into main pieces (breast, thighs and drumstick), the bone and fatty tissues were removed. Prepared slices of meat were cut at the thickness of 1.5 cm and at the weight of 100g each (Al-Fayyadh and Naji, 2012).

Physical test

Water Holding Capacity (WHC)

WHC was estimated using the protocol of Denhertog *et al.* (1997), 50g of meat samples were mixed with distilled water and centrifuged at 4°C (5000°/ min) for 10 min. It is estimated as follows:

$$\text{WHC}(\%) = \frac{\text{Weight of water added to meat (gm)} - \text{Water weight after centrifugation}}{\text{Model weight (g)}} \times 100$$

Thawing loss

Thawing loss was estimated according to Nam *et al.* (2000). Frozen meat samples were weighed, placed in the refrigerator at a temperature at 5°C for 24h to dissolve. The fluid was removed, re-weighed and then the percentage of loss was extracted during the melting according to the following formula

$$\text{Thawing loss}(\%) = \frac{\text{Frozen sample weight (gm)} - \text{Sample weight after dissolving and removal of liquid (g)}}{\text{Frozen sample weight (g)}} \times 100$$

Drip loss

Drip loss was estimated using Alvarado and Sams (2004). The fresh meat samples were weighed and placed them in polyethylene bags. It was kept 5°C for 24h. These samples were re-weighed again after drying the surface of the meat from the liquid using filter paper. This drip loss was calculated using the following formula:

$$\text{Drip loss}(\%) = \frac{\text{The primary weight of the meat} - \text{The final weight meat}}{\text{Primary meat weight}} \times 100$$

Cooking loss

Cooking loss was estimated by Rasmussen and Mast (1989). The samples of meat were weighed before cooking and packed at heat resistant plastic bags weighing 20g for each sample. It was cooked in a water bath at 80°C, then weighed after cooking after excluding the resulting liquid from cooking, It was estimated as follows:

$$\text{Cooking loss}(\%) = \frac{\text{Weight before cooking} - \text{Weight after cooking}}{\text{Weight before cooking}} \times 100$$

Shear force

10 x 10mm pieces of meat were cut and displayed parallel to the cut-off power plant locally and the cutting strength of each sample was read according to the scale in the device.

Statistical analysis

Data generated from the present experiment was subjected to statistical analysis using the GLM procedure of SPSS (2009) statistical software package. When significant differences were noted, mean were compared using Duncan (1955) test of multiple range to assess any significant difference at the probability level of P<0.05 among the experimental treatments.

RESULTS AND DISCUSSION

The results in Table 1. indicate that the vinegar treatment (T_2) showed the highest value (P<0.05) at all tissue types (breast, thigh, and drumstick) with high. Water Holding Capacity (WHC) compared to bromelain treatments (T_3, T_4 and T_5). The high values in the vinegar may be due to the fact that the vinegar contains acidic carboxyl group which reduces the value of the pH (Istrati *et al.*, 2012). A significant increase (P<0.05) for bromelain enzyme treatments was seen compared to the control treatment (distilled water). When comparing the treatments of bromelain, it was observed that the T_5 treatment (P<0.05) showed the best results (P<0.05) compared to T_4, which was significantly higher (P<0.05) than T_3 (0.05% bromelain enzyme). As for the improvement in promelain treatments, this may be due to the effectiveness and activity of the bromelain enzyme in the process of protein degradation and water infiltration between meat protein molecules (Buyukyavuz, 2014). In Table 1 it is showed that all bromelain treatments significantly decreased (P<0.05) compared to the negative control treatment (T_1) and to all the major losses in thawing loss traits, This may be due to the action of bromelain-free enzymes, which has resulted in better availability at a number of binding sites between proteins and water. It has also increased water holding capacity, increased moisture content and

Table 1. Effect of bromelain enzymes tenderization on water holding capacity and thawing loss of spent hen meat

S. No	Treatments	Water holding capacity (%)			Thawing loss (%)		
		Breast	Thigh	Drumstick	Breast	Thigh	Drumstick
1	Distilled water	35.40 ± 0.02^{e}	33.20 ± 0.02^{e}	34.20 ± 0.02^{e}	4.27 ± 0.15^{a}	3.73 ± 0.03^{a}	3.03 ± 0.03^{a}
2	Venegar 1%	48.37 ± 0.04^{a}	47.10 ± 0.03^{a}	47.80 ± 0.02^{a}	3.73 ± 0.09^{b}	2.90 ± 0.06^{b}	2.77 ± 0.03^{b}
3	Bromelain 0.05%	46.40 ± 0.03^{d}	44.82 ± 0.04^{d}	47.10 ± 0.03^{c}	3.03 ± 0.03^{bc}	2.63 ± 0.03^{c}	2.47 ± 0.03^{c}
4	Bromelain 0.10%	46.80 ± 0.03^{c}	44.98 ± 0.02^{c}	46.12 ± 0.01^{d}	2.87 ± 0.03^{cd}	2.37 ± 0.03^{d}	2.23 ± 0.12^{d}
5	Bromelain 0.15%	47.60 ± 0.04^{b}	46.80 ± 0.02^{b}	47.60 ± 0.04^{b}	2.63 ± 0.03^{d}	2.23 ± 0.03^{e}	2.07 ± 0.03^{d}
6	Significant value	*	*	*	*	*	*

Table 2. Effect of bromelain enzymes tenderization on drip loss and cooking loss of spent hen meat

S. No	Treatments	Drip loss (%)			Cooking loss (%)		
		Breast	Thigh	Drumstick	Breast	Thigh	Drumstick
1	Distilled water	4.57±0.12[a]	3.73±0.09[a]	2.53±0.09[a]	36.13±0.35[a]	28.10±0.56[a]	23.63±0.57[a]
2	Venegar 1%	3.36±0.12[b]	3.93±0.09[b]	2.23±0.07[b]	31.10±0.15[b]	25.20±0.61[b]	21.00±0.80[b]
3	Bromelain 0.05%	3.72±0.04[b]	2.57±0.07[bc]	2.07±0.03[bc]	29.03±0.32[c]	24.20±0.12[b]	19.70±0.36[c]
4	Bromelain 0.10%	3.38±0.04[c]	2.45±0.02[cd]	1.87±0.09[cd]	28.73±0.55[c]	23.83±0.20[c]	18.87±0.40[cd]
5	Bromelain 0.15%	3.13±0.07[c]	2.27±0.09[d]	1.73±0.03[d]	28.07±0.32[c]	23.00±0.12[c]	18.13±0.31[d]
6	Significant value	*	*	*	*	*	*

reduced loss (Kemp *et al*., 2010), as well as the increase in the association of water with proteins that may be due to low pH values due to the fact that the pH away from the electric breakout point, which increased the attraction between the molecules of water and protein and thus increase the strength of the connection between them (Lind *et al*., 1971).

The results in Table 2 showed that bromelain enzyme treatments resulted in a significant decrease (P <0.05) in drip loss comparison to the distilled water treatment in all the main cuts of spent hen carcass, It may be due to the increase in ionic strength and the lack of overlap between proteins and their flux and increase in water binding sites, which led to water retention and decrease in muscle fibers, resulting in a reduction in the amount of drip loss (Manohar and Vishnupriya, 2016). Lower drip loss in the bromelain treatments of meat samples with due to decreased pH value and thus increase moisture content (Sung, 2018).

In Table 2, the results showed a significant decrease (P<0.05) in the cooling loss in all bromelain enzyme treatments compared with T_1 and T_2 in the main carcass (breast, thigh and drumstick). This may be due to increased meat water holding capacity and higher moisture content due to the lower pH value of the meat samples and its distancing from the electrode, which eventually leads to an increase in the amount of electrical charge in the meat proteins and the creation or making of spaces between the muscle fibers, which reduces the percentage of loss during cooking (Smith *et al*., 2014).

Table 3 shows that the high concentrations of bromelain (0.15%) resulted in a significant decrease (P<0.05) in shear force compared to T_4 (P<0.05) and T_3 (P<0.05). It is noted that the treatment of distilled water resulted in a significant increase (P<0.05) in the cutting force compared to the vinegar treatment.

Smith *et al*. (2014) reported that the solution of solutions, including water, salt and sodium phosphate, from the ducks' breast greatly reduced shear force compared to the control treatment (distilled water). In this study, all samples treated with different concentrations of bromelain greatly worked towards meat tenderization, although samples treated with bromelain 0.05% were the only treatment for bromelain in which shear force was decreased compared with T_2 and T_1.

Table 3. Effect of bromelain enzymes tenderization on shear force of spent hen meat

S. No	Treatments	Shear force (%)		
		Breast	Thigh	Drumstick
1	Distilled water	3.62±0.03[a]	3.45±0.02[a]	3.53±0.02[a]
2	Venegar 1%	2.73±0.01[b]	2.54±0.02[b]	2.60±0.02[b]
3	Bromelain 0.05%	2.32±0.02[c]	2.26±0.02[c]	2.30±0.02[c]
4	Bromelain 0.10%	2.24±0.01[d]	2.18±0.0[d]	2.21±0.01[d]
5	Bromelain 0.15%	1.94±0.01[e]	1.86±0.02[e]	1.91±0.01[e]
6	Significant value	*	*	*

CONCLUSION

Use of bromelain enzyme has significantly improved all the physical parameters (water holding capacity, thawing loss, drip loss and cooking loss) of all main cutts (chest, thigh, and drum stick) of the spent hen meat compared to the distilled water and vinegar.

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