



## EFFECT OF BROMELAIN ENZYME TENDERIZATION ON COLLAGEN OF SPENT CHINESE WHITE DUCK MEAT

Hussian M. K. Al-Dhalimi<sup>1\*</sup>, Saad K. J. Al-Waeli<sup>2</sup>, Ahmed R. M. A Alkhateeb<sup>2</sup>  
and Jassim K. M. Al-Gharawi<sup>2</sup>

<sup>1</sup>General Sciences Department, Basic Education College, Al-Muthanna University, Iraq.

<sup>2</sup>Animal Production Department, Agriculture college, Al-Muthanna University, Iraq.

### Abstract

This study was conducted to determine the effect of the enzyme bromelain on collagen of spent duck meat, cuts of breast, thigh and drumstick were randomly taken from 20 spent Chinese white ducks, 52 weeks age, the experiment was conducted in the laboratories of the college of Agriculture, Al-Muthanna University from 29/10/2018 to 13/12/2018. The cuts were placed in different concentrations solutions of the bromelain enzyme (0.1%, 0.15%, 0.2%) for the treatments (T5, T4, T3) respectively, other samples were placed or submerged in two coefficients: negative control distilled water (T1) and positive control vinegar 1% (T2), to study the effect of different solutions on collagen of spent Chinese white duck meat, bromelain was purchased from India's Maple Life sciences. The results indicated a significant effect ( $p < 0.05$ ) on the amount of dissolved collagen and insoluble collagen in immersed samples in the bromelain enzyme. There was no significant differences in total collagen amount of bromelain submerged samples compared with T2 and T1 comparison treatments.

**Key words:** bromelain enzyme, tenderization, collagen, spent, Chinese white duck, meat.

### Introduction

Collagen is the main protein of connective tissue in muscles, skin, ligaments, cartilage and bones and makes up a large proportion of about 25% of the body's total proteins, the strong bundles of collagen proteins together form what are known as collagen fibers (Orgel, 2009). There are 12 types of collagen that differ from each other because of the sequence of amino acids in the primary peptide chain and their association with different carbohydrate molecules (Lawrie, 1991), amino acid claysin makes up part of all amino acids, other part of the total amino acids that make up collagen, the amino acid proline and hydroxyproline. (Matthew and Raines, 2009). Bailey (1989) categorized collagen into three main groups, fiber-forming collagen, non-fibrous collagen and collagen for the filamentous parts of muscles. The collagen has a great effect on the meat of spent birds through its strong fibers and the difficulty of melting which gives hardness in the meat and increases the duration of cooking (Ruantrakool and Chen, 1986), Because tropocollagen molecules are strongly bound to one another by transverse

bonds (McCormick, 1999), when advancing in bird life leads to an increase in the amount of collagen and an increase in the formation of transverse bonds that make the meat more solid (Nakamura *et al.*, 1975).

The aim of this study is to investigate the effect of bromelain enzyme supplements on collagen of spent duck meat.

### Materials and Methods

#### Birds used in the experiment

A total of 20 spent Chinese ducks aged 52 weeks, with an average live weight of 4850 g, Purchased from local markets in Muthanna province, the birds were transferred to the laboratories of the College of Agriculture, Al-Muthanna University, from 29/10/2018 to 13/12/2018. Birds fasted for 12 hours to minimize contamination during preparation, slaughtered in the traditional way, scalding and cleaning process was packed in vacuum bags of polyethylene, kept in refrigeration at 5 °C for 24 hours, the carcasses were cut into head pieces and the thighs, breast and drumstick cuts were taken, bones and adipose tissue were removed, cut 1.5 cm thick

\**Author for correspondence*: E-mail: althally.hussian@gmail.com

and weighing 100 grams each, superficially washed samples, the samples were placed individually (breast, thigh and drumstick) separately in airtight polyethylene bags and closed tightly.

### Experience design

A total of 20 spent Chinese white ducks, 52 weeks old, at similar weight rates, duck carcasses were distributed to five experimental treatments (four birds per treatment), each sacrifice was cut into three main cuts: breast, thigh, drumstick, three replicates were taken from each cut, the treatments were as follows:

T1: treatment control soaking meat in distilled water.

T2: soaking meat in a solution containing 1% vinegar.

T3: soaking meat in a solution containing the enzyme bromelain at a concentration of 0.1%.

T4: soaking the pieces in a solution containing the enzyme bromelain at a concentration of 0.15%.

T5: soaking the pieces in a solution containing the enzyme bromelain at a concentration of 0.2%.

### Meat collagen estimate

The amount of collagen in meat samples was estimated according to the method described by Tahir (1979), which is based on the estimation of the amount of amino acid hydroxyproline which expresses the amount of collagen.

### Statistical analysis

Completely Randomized Design (CRD) were used, significant differences between means were comparative by Duncan multiple range (1955), all data were analyzed by SPSS program (2009).

## Results and Discussions

Table (1, 2, 3) shows the effect of bromelain enzyme tenderize on dissolved, insoluble and total collagen in elderly duck meat, T5 was a significantly increased ( $P < 0.05$ ) in meat of thigh and drumstick compared to

**Table 1:** Effect of Bromelain Enzyme tenderization on Soluble Collagen in spent Duck Meat (Mean  $\pm$  Standard Error).

Soluble Collagen (Mg / g meat)			Treatment
Drumstick	Thigh	Breast	
0.02 $\pm$ 3.78d	0.07 $\pm$ 3.54d	0.08 $\pm$ 3.25b	T1
0.02 $\pm$ 3.68c	0.25 $\pm$ 3.64d	0.02 $\pm$ 3.38b	T2
0.03 $\pm$ 4.22b	0.02 $\pm$ 3.88c	0.02 $\pm$ 3.56b	T3
0.01 $\pm$ 4.27b	0.02 $\pm$ 4.16b	0.02 $\pm$ 3.76ab	T4
0.02 $\pm$ 4.46a	0.02 $\pm$ 4.34a	0.35 $\pm$ 4.21a	T5
*	*	*	Sig.
*Different letters vertically indicate the existence			

**Table 2:** Effect of Bromelain Enzyme tenderization on insoluble Collagen in spent Duck Meat (Mean  $\pm$  Standard Error).

Insoluble Collagen (Mg / g meat)			Treatment
Drumstick	Thigh	Breast	
0.02 $\pm$ 8.74a	0.02 $\pm$ 8.54a	0.02 $\pm$ 5.66a	T1
0.02 $\pm$ 8.36b	0.02 $\pm$ 8.24b	0.03 $\pm$ 5.25b	T2
0.02 $\pm$ 8.24c	0.02 $\pm$ 7.98c	0.02 $\pm$ 5.12c	T3
0.02 $\pm$ 8.12d	0.03 $\pm$ 7.87d	0.03 $\pm$ 4.96d	T4
0.03 $\pm$ 7.64e	0.03 $\pm$ 7.48e	0.03 $\pm$ 4.48e	T5
*	*	*	Sig.
*Different letters vertically indicate the existence			

treatment T4 in dissolved collagen, T4 was significantly superior ( $P < 0.05$ ) compared to the significantly superior treatment T3 ( $P < 0.05$ ) compared to T1 and T2 in the thigh meat, no significant differences were observed between T5 and T4 treatments on the one hand and T1, T2 and T3 treatments on the other hand in breast meat, no significant differences were observed between T1 and T2 treatments in thigh meat and T3 and T4 treatments in the drumstick meat. In insoluble collagen, T5 decreased significantly ( $P < 0.05$ ) compared to significantly lower T4 treatment ( $P < 0.05$ ) compared to treatment T3, which decreased significantly ( $P < 0.05$ ) compared to treatment and significantly lower ( $P < 0.05$ ) compared to treatment T1 in the breast, thigh and drumstick meat. However, in total collagen, no significant effect was observed on all breast meat treatments, while treatment T1 and T4 increased significantly ( $P < 0.05$ ) compared to T2, T3 and T5 treatments in thigh meat, in drumstick meat, there was a significant decrease ( $P < 0.05$ ) in T2 and T5 compared with T3 and T4. The treatment T4 decreased significantly ( $P < 0.05$ ) compared to the control treatment, no significant difference was observed between T1 and T3 and T3 and T4.

It is concluded that bromelain tenderized resulted in significant increase in dissolved collagen and decrease in insoluble collagen, the reason is that bromelain has worked

**Table 3:** Effect of Bromelain Enzyme tenderization on insoluble Collagen in spent Duck Meat (Mean  $\pm$  Standard Error).

Total Collagen (Mg / g meat)			Treatment
Drumstick	Thigh	Breast	
0.01 $\pm$ 12.52a	0.06 $\pm$ 12.08a	0.07 $\pm$ 8.91	T1
0.03 $\pm$ 12.04c	0.04 $\pm$ 11.88b	0.03 $\pm$ 8.63	T2
0.04 $\pm$ 12.46ab	0.01 $\pm$ 11.86b	0.03 $\pm$ 8.68	T3
0.03 $\pm$ 12.39b	0.04 $\pm$ 12.03a	0.04 $\pm$ 8.72	T4
0.05 $\pm$ 12.10c	0.05 $\pm$ 11.82b	0.37 $\pm$ 8.69	T5
*	*	*	Sig.
*Different letters vertically indicate the existence. N.S: Non-Significant.			

to break the transverse bridges within the collagen molecule and has led to increased melting of collagen, because the number of transverse bridges and collagen bonds is a measure of collagen solubility (Ionescu *et al.*, 2008). Naveena and Mendiratta (2001) reported that the increase in collagen solubility when immersing meat samples in bromelain solution may be due to activity and increased efficacy of collagen-decomposing enzymes such as collagenase and cathepsinase, which act on the cleavage of collagen fibers (Suzuki *et al.*, 1985). The decrease in total collagen in thigh meat samples and drumstick immersed in different concentrations of bromelain solution may be due to the high ionic strength of the solution, which leads to breakage of lateral bonds and transverse bridges between the collagen fibers (Ketnawa and Rawdkuen, 2011, Bille and Taapopi, 2008), the use of bromelain powder in tenderization changes the nature of protein by breaking down collagen chains, muscle fibers and bonding tissues, it breaks down the chain of myosin protein as well as changes the nature and breakage of collagen, fiber and muscle tissue, enzymes increased the rate of dissolved collagen and increased structural changes, breaking the bonds of solid collagen (Rawdkuen and Benjaakul, 2012).

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