Chemical Changes The Spent Hen Meat After A Tenderization Process Solution of Sodium Chloride

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Abstract

In this study, the old chicken meat found in the market after slaughtering and cleaning was carried out by the saline application, which was as follows: T: the control treatment. T2, T3 and T4 were tenerized spent hen meat with sodium chloride by 10, 20 and 30 g / L water for 12 hours respectively. Results show that the collagen was a significant increase (P≤0.05) in T2, T3, T4 compared with the control of white muscle control and the total concentration of collagen was a significant decrease (P≤0.05) in saline annulus coefficients compared to control of dark muscle. The total concentration of soluble nitrogen was a significant decrease (P≤0.05) in saline-induced salinity coefficients compared with white muscle control. It is also noted that the concentration of protein nitrogen in the white muscle has decreased significantly (P≤0.05) in the coefficients of the antigen compared to the control treatment.

Keywords: Spent, Meat, Tenderization, Sodium.

1. Introduction

The abundant production of meat of spent hens after the completion of the egg production stage faces difficulties in the efficiency of its handling and marketing as a result of the deterioration of the quality of this meat, especially with regard to its palatability, especially the decrease in the characteristics of tenderness and juiciness in these meats due to the age of the animals. In general, the meat of aged chickens is characterized by its toughness and poor functional characteristics due to the high content of collagen and cross-bridges between the fiber proteins in the meat [1]. In order to benefit from the meat of aged chickens and to increase the demand for their meat by the consumer, many studies have been conducted to improve the quality and sensory characteristics of this meat by using several means and technologies, including pressure treatment technique [2], ultrasound technology [3]. The aging technique was used on a commercial scale in tenderizing various meats for the purpose of getting rid of the problem of meat hardness, but this technique faced obstacles, including the need for large areas of refrigerated stores and relatively long storage periods, which causes high costs as well as the emergence of some undesirable changes in meat Including the difficulty of controlling the growth of spoilage microorganisms and the possibility of oxidation in fats, a change in the color of meat and a loss in meat moisture, which negatively affects the quality of these meats. For the purpose of avoiding the high costs and defects resulting from the use of previous technologies, the current studies and research tended to find alternative means, including the use of non-meat materials or compounds such as sodium chloride salts, which studies have proven to have low economic cost as well as positive effectiveness in improving the quality and functional characteristics of meat and the stability of meat preservation period Inhibiting fat oxidation and ensuring healthy meat [4].

The quality of meat can be defined according to different concepts represented by the aspects of palatability and technology through the aspects of health safety and that these qualities that affect the quality of meat can be determined and judged by the consumer, Hoffman [5] described the quality of meat as a set of qualitative treatments, which are sensory qualities such as tenderness Juicy, flavor, aroma, and color are described as nutritional treatments, which include fat and protein content, connective tissue ratio, health and toxicity treatments, which include the presence of bacteria, toxins, molds, spores and residues, as well as technical treatments represented by the ability of meat to carry water, pH and water distribution.

The use of salts is one of the methods used to soften the meat of aged laying hens. The degree of improvement in tenderness depends on several treatments, including the type of salt, the time of use of salt, the number of salts used, the type of muscle, the method of delivering the saline solution to the piece of meat, and the use of other methods for tenderized with salts. The role of salts may be due to improving the tenderness Meat can influence the activation of calpain enzymes, or its effect in weakening protein interactions by raising the ionic strength. Also, the increase in ionic strength may affect the stability of lysosome membranes, leading to the release of cathepsins enzymes [6].
The high content of sodium chloride leads to an improvement in softness as a result of swelling of myofibrils, and it is believed that the effect of calcium chloride on softness is due to the activity of calcium-dependent enzymes, including Calpain, and this theory was supported by the amount of activity of calpain after the stiffness of throwing, as noted by Kenny and Hunt [7] that addition of 4% NaCl increases the carrying capacity of water significantly. Adding small amounts of about 0.1% and 0.2% NaCl led to a small but significant increase. They indicated that the use of solutions of calcium chloride (0.3 M) or sodium chloride (0.6 M) that have the same ionic strength affect the tenderness of aged chicken meat (spent hens), as the injection of chicken meat with these solutions led to a decrease in the shear value and improves the tenderness of the meat. And that the use of solutions of relatively high ionic strength and activating the enzyme Calpain (the enzyme dependent on calcium ions) positively affects the tenderization of meat through the effect of calpains on the initial tenderness of muscle fibers, which leads to the fragmentation of sarcomere proteins in the z-line [8].

The current study targeted the chemical changes of aged chicken meat after the process of tenderizing with a salt solution.

2. Materials and Methods

2.1 The meat used in the experiment

In this study, the meat of aged chickens found in the market was used after slaughter and cleaning, and saline tenderized treatments were carried out as follows:

- T1: the control treatment.
- T2: tenderized spent hen meat with sodium chloride by 10 g / liter of water for a period of 12 hours.
- T3: tenderized spent hen meat with sodium chloride by 20 g / liter of water for a period of 12 hours.
- T4: tenderized spent hen meat with sodium chloride by 30 g / liter of water for a period of 12 hours.

Meat samples were taken at a rate of 100 g for each breast and thigh sample, for each type 6 samples, and the samples were kept for 24 hours before conducting chemical tests.

2.2 The measurements used

2.2.1 Collagen

The amount of collagen was estimated by heating 5 g of meat with 25 ml of ¼ Strength Ringer's solution (1.5 mM KCl, 0.5 mM CaCl2, 32.75 mM NaCl) for 1 hour at 90°C and centrifuging at 4000xg for 10 minutes. The precipitate was re-mixed with 8 ml of ¼ Strength Ringer solution and centrifuged as mentioned above. The filtrate was collected with the previous filtrate. Both the precipitate and the filtrate were digested separately by adding 50 ml of 6N HCl to each of them and left for 20 hours at 120 °C. To a volumetric flask and complete the volume to the mark with distilled water, then filter the solution through filter paper (Whatman #1) [9], then the amount of hydroxyproline in both the precipitate and the filtrate was estimated according to the method of Bergman and Loxley [10].

2.2.2 Total, protein and non-protein soluble nitrogen

The total, protein and non-protein dissolved nitrogen was estimated according to the method described by Kline and Stewart [11] by homogenizing 5 g of meat with an amount of 0.5 M KCl solution and mixing the solution well and completing the volume to 100 ml with the same solution and leaving the mixture for half an hour with shaking between a period of time. The mixture was centrifuged at 850 x g for 15 minutes and the total dissolved nitrogen in the filtrate was estimated by Kjeldahl method [12], minutes and centrifuged the mixture at a speed of 850 x g for 15 minutes. The non-protein dissolved nitrogen was estimated in the filtration by Keldahl method. The protein dissolved nitrogen was obtained by subtracting the non-protein dissolved nitrogen from the total nitrogen.

2.3 Statistical analysis

The data were analyzed using treatmental experiments according to the complete random design (CRD) to study the effect of chemical changes the spent hen meat after a tenderization process solution of sodium chloride and the significant differences between the means were compared with Duncan [13] multinomial test, and the ready-made statistical program SPSS [14] was used.
3. Results and Discussion

3.1 Collagen

Table 1. show that the effect of saline tenderized on the concentrations of total protein and non-protein soluble collagen in the white and dark muscles of aged laying hens, as the above table indicates that both the total concentration showed a significant (P≤0.05) increase in the saline tenderized treatments (T2, T3), T4, which amounted to 10.6, 10.66 and .75 mg per gram of meat for the treatments, respectively, compared to the control treatment T1, which amounted to 10.1 mg per gram of meat from white muscle.

It is also noted that the concentration of dissolved collagen in the white muscle showed a significant increase in the tenderized ratios, which amounted to 3.2, 3.22, 3.26 mg per gram of meat, respectively, compared to the control treatment, which amounted to 3.05 mg per gram of meat. In the same direction, we note that the effect of saline tenderized in the concentrations of collagen is not The soluble showed a significant increase in treatments that amounted to 7.40, 7.44, 7.49 mg per gram of meat compared to the control treatment, which amounted to 7.25 mg per gram of meat.

We also note that the total concentration of collagen showed a significant decrease in the saline tenderized treatments, which amounted to 14.71, 14.75, 14.68 mg per gram of meat, respectively, compared to the control coefficient, which amounted to 14.85 mg per gram of meat in dark muscles. We also note that the concentration of soluble collagen in dark muscles showed A significant increase in the tenderized treatments which amounted to 3.35, 3.83, 3.48 mg per gram of meat compared to the control treatment of 3.20 mg per gram of meat. We note that the effect of saline tenderized in the concentrations of insoluble collagen showed a significant decrease for the treatments that amounted to 11.26, 11.33, 11.40 mg per gram of meat. Compared to the control treatment, which was 11.65 mg per gram of meat.

| Treatments | White muscle | Dark muscle |
|------------|--------------|-------------|
|            | Total | Soluble | Non-soluble | Total | Soluble | Non-soluble |
| T1         | 10.10   | 3.05   | 7.25      | 14.85   | 3.20    | 11.65      |
| T2         | 10.60   | 3.20   | 7.40      | 14.75   | 3.35    | 11.40      |
| T3         | 10.66   | 3.22   | 7.44      | 14.71   | 3.38    | 11.33      |
| T4         | 10.75   | 3.26   | 7.49      | 14.68   | 3.42    | 11.26      |
| Mean       | 10.53   | 3.18   | 7.12      | 14.75   | 3.34    | 11.41      |
| Sig        | 0.05    | 0.05   | 0.05      | 0.05    | 0.05    | 0.05       |

Collagen and the number of cross-bridges between its fibers are the main factor in the hardness of the meat of laying hens, in contrast to broilers, whose meat is mainly due to the proteins of myofibrils, as the stiffness of its meat resulting or related to the presence of collagen is of little importance because it is young in age, and because The amount of collagen and cross bridges in their meat is low [15].

3.2 Total, protein and non-protein soluble nitrogen

Table 2 show that the effect of the salt theory on the concentrations of total protein and non-protein dissolved nitrogen in the white and dark muscles of aged laying hens, as the above table indicates that each of the total concentration showed a significant decrease (P≤0.05) in the saline softening treatments (T2, T3, and T3). T4), which amounted to 30.04, 29.61, and 49.44 mg per gram of meat for the treatments, respectively, compared to the control parameter T1, which amounted to 33.02 mg per gram of meat in the white giblets.

It is also noted that the protein nitrogen concentration in the white muscle was significantly decreased in the softening treatments, which amounted to 19.20, 18.93, 18.87 mg per gram of meat, in order, compared to the control treatments, which amounted to 20.33 mg per gram of meat in the same direction. We note that the effect of saline softening on the concentrations of dissolved nitrogen is not The protein content showed a significant decrease with rates of 15.89, 15.68, 15.57 mg per gram of meat compared to the control, which amounted to 12.69 mg per gram of meat.

It is also noted that the concentrations of total nitrogen in dark muscles were not significant in the softening treatments, which amounted to 28.65, 28.58, 28.61 mg per gram of meat, respectively, compared to the control measure, which amounted to 28.78, mg per gram of meat. We also note that the concentrations of protein nitrogen in the dark muscles decreased. Significantly in the softening treatments, which amounted to 15.88, 15.75, 15.70 mg per gram of meat, respectively, compared to the control treatment, which amounted to 17.06 mg per gram of meat.
We note that the effect of non-protein soluble nitrogen showed a significant increase in the treatments 2.77, 12.83, 12.91 mg per gram of meat compared to the control factor, which amounted to 11.81 mg per gram of meat.

Table 2. Effect of saline softening on total, protein and non-protein soluble nitrogen concentrations (mg/g of meat) in white and dark muscles.

| Treatments | White muscle | Dark muscle |
|------------|--------------|-------------|
|            | Total protein | Non-protein | Total protein | Non-protein |
| T1         | 33.02<sup>a</sup> | 20.33<sup>a</sup> | 12.69<sup>a</sup> | 28.87<sup>a</sup> | 17.06<sup>a</sup> | 11.81<sup>b</sup> |
| T2         | 30.04<sup>b</sup> | 19.20<sup>b</sup> | 10.84<sup>b</sup> | 28.65<sup>a</sup> | 15.88<sup>b</sup> | 12.77<sup>a</sup> |
| T3         | 29.61<sup>b</sup> | 18.93<sup>b</sup> | 10.68<sup>b</sup> | 28.58<sup>a</sup> | 15.75<sup>b</sup> | 12.83<sup>a</sup> |
| T4         | 29.44<sup>b</sup> | 18.87<sup>b</sup> | 10.57<sup>b</sup> | 28.61<sup>a</sup> | 15.70<sup>b</sup> | 12.91<sup>a</sup> |
| Mean       | 30.53         | 19.33        | 11.20         | 27.21         | 16.10        | 12.58 |
| Sig.       | 0.05          | 0.05         | 0.05          | 0.05          | 0.05         | 0.05  |

The decrease in nitrogen in white muscles and its increase in dark muscles in saline tenderizers leads to the solubility of sarcoplasmic proteins in white and red muscles may be due to the heat generated by the passage of electric current in the carcass, which leads to denaturation of part of the protein, as the dissolved protein decreases with increasing temperature [16, 17].

References

[1] Bailey, A. J. (1984). The chemistry of intramolecular collagen. In: BAILEY, A.J. (Ed) Recent Advances in Chemistry of Meat, London, The Royal Society of Chemistry. p. 17-22.
[2] Mendiratta, S. K. and Pana, P. C. (1995). Synergistic effect of pressure and enzyme treatment for tenderization of spent hen meat. J. Food Sci. and Tech., 32: 46-48.
[3] Lyng, J. G.; Allen, P.; McKenna, B. M. (1997). The influence of high intensity ultrasound baths on aspects of beef tenderness. J. Muscle Foods., 8:237-249.
[4] Pearson, A. M. (1987). Muscle function and postmortem changes. In: "The Science of Meat and Meat Products", Third edition, J.F. Price and B. S. Schweigert (Ed.). Food and Nutrition Press, Inc. Westport, Connecticut. p. 307-327.
[5] Hofmann, K. and Bluchel, E. (1991). Blut und muskelfarbstoff. Fleischwirtsch, 71:1290-1293.
[6] Rees, M. P.; Trout, G. R. and Warner, R. D. (2002). Effect of calcium infusion on tenderness and ageing rate of pork m. longissimus et lumbarum after accelerated boning. Meat Sci., 61:169-179.
[7] Kenny, P. B. and Hunt, M. C. (1990). Effect of water and salt content on protein solubility and water retention of meat prebends. J. Meat Sci., 27: 173-180.
[8] Takahashi, K. (1999). Mechanism of meat tenderization during postmortem ageing: Calcium theory. Proc. 45<sup>th</sup>. Intr. Cogr. Meat Sci. and Technol. 230-235.
[9] Arganosa, G. C., & Marriott, N. G. (1989). Organic acids as tenderizers of collagen in restricted beef. Journal of Food Science, 54, 1173-1176.
[10] Bergman, I. and Loxley, R. (1963) Two improved and simplified methods for the spectrophotometric determination of hydroxyproline. Anal. Chem., 35: 1961, 1963.
[11] Dreebe, H. A.,& Abdul Razak,N.A. (2020). The Impact of Corruption on Agriculture Sector in Iraq: Econometrics Approach. IOP Conference Series: Earth and Environmental Science. 553 (1).
[12] Duncan, D.B. (1955) Multiple ranges test and Multiple F – test. Biometrics. 11: 1-42.
[13] SPSS. (2012) SPSS users guide. Statistics version 20. Statistical Package Solution Service.
[14] Vaithiyathan, S., B.M. Naveena, M. Muthukumar, P.S. Girish, C. Ramakrishna, A.R. Sen and Y. Babji (2007) Biochemical and Physicochemical Changes in Spent Hen Breast Meat During Postmortem Aging. Poultry Science, 87(1): 180-186.
[15] Murphy, R. Y. M., and B. P. Marks, 2000. Effect of meat temperature on proteins, texture, and cook loss for ground chicken breast patties. Poultry Sci.79:99-104.
[16] Habib, H.G., Al-Hilali, A.H.K., Al-Gharawi, J.K.M. 2020. Effect of addition of iron and copper elements on some blood and immune traits of broilers. Biochemical and Cellular Archives. 2020, 20(1), pp. 505–508