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# Quality Evaluation of Gelatin Extracted from Chicken Feet of Different Ages

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**Abstract:** ***This study aims to evaluate quality of gelatin extracted from feet of ROSS chicken at different ages. The ages studied were 12, 14 and 16 weeks. The following parameters were evaluated: yield percentage, pH, gel strength, gel viscosity, gel melting point, water holding capacity and color properties were evaluated. The highest value of gelatin yield was obtained in 16 weeks' age chicken feet. While the highest value of gel strength 138.3 bloom was obtained in 12 weeks' age chicken feet. However, there were no significant ($p \geq 0.05$) differences in the pH values measured in the gelatin in terms of chicken ages. It was observed that no significant ($p \geq 0.05$) differences in WHC measured in gelatin extracted from 12 weeks' age chicken feet. The lightest gelatin (L* 80.5) was obtained in the control sample followed by 64.9, 63.1 and 60.7 which obtained in the gelatin extracted from the chicken ibn the age of 14, 15 and 12 age, respectively. The same trend was observed in the values of the yellowness as the highest value of (b* 25.7) at the age of 12 weeks, followed by (b* 22.8) in the gelatin of 14 weeks' age one. However, the highest redness value (a* 6.1) was observed in the gelatin of the chicken of 12 weeks' age, followed by 14 weeks. The quality properties of the gelatin were highly depending on the ages of chickens.***

**Keywords:** gelatin quality, chicken feet, age effect, physical properties, color properties

## 1. Introduction

Gelatin is a protein substance that comes from collagen protein, which is widely found in the connective tissues of all animals, such as bones, cartilage, skin, and muscle tendons. It is a word derived from a Latin verb (gelatin), which means the ability to form gel. Gelatin is characterized by multiple important functional characteristics. In addition to being considered a protein source, it is used in many food industries because of its functional qualities, including: high ability to bind with water, ability to emulsify, ability to form foam, ability to give viscosity, ability to give elasticity, ability to form a layer surrounding the food substance, and gelatin possesses some functional properties that distinguish it from Other polymers that have the ability to form gels, such as pectin and starch [1]. It is its ability to thermally transform into a gel and its ability to melt and solidify several times without breaking. Technically, it can be used as an ingredient to improve the elasticity, viscosity, texture, emulsification and stability of foods, especially in the field of manufacturing sweets, dairy products and meat. It is also used for packaging and the formation of a film that is of great benefit in industrial uses. Such as pharmaceutical, medical, and cosmetic materials because it has unique functional characteristics [2]. Gelatin contains nine essential amino acids out of ten, so it is not considered a complete protein [3]. The use of gelatin is not limited to foods and their products, but extends to many uses, especially in the manufacture of Pharmaceutical supplies. Many studies have been conducted on extracting gelatin from chicken feet for various purposes [4 – 6]. Slaughterhouse waste constitutes a source of environmental pollution and affects human health. It must be dealt with and treated to protect the environment from pollution and benefit from the waste, recycling it and turning it into secondary products that can be used [7]. This study aims at evaluating quality properties of gelatin extracted from chicken feet produced from local poultry slaughterhouses.

## 2. Materials and methods

### 2.1. Materials

a) Fresh chicken feet of the ROSS strain were obtained from the model poultry slaughterhouse in the city of Buraidah/Qassim for the purpose of extracting gelatin from them. Chicken feet resulting from the aforementioned strain at three different ages (12, 14 and 16 weeks) were selected for extraction.
b) Solution of hydrochloric acid, sodium hydroxide, acetic acid
c) Distilled water
d) A piece of cloth
e) Standard gelatin

### 2.2. Sample preparation

Chicken feet were prepared in the meat laboratory, College of Agriculture and Veterinary Medicine, Qassim University. The chicken feet samples were cleaned by removing the skin and fat. The samples were soaked in boiling water at 100°C for 40 minutes. After that, the chicken feet were dried in a drying oven in food analysis laboratory at a temperature of 50°C for 18 hours. The dried chicken feet were then soaked in hydrochloric acid solution after removing mineral salts by alkaline treatment. This process was performed at a temperature of 27 ± 1°C (room temperature). The soaking solution was changed at intervals of every 3 days for 9 days.

### 2.3 Extraction of gelatin

The samples were cleaned by removing the skin and fat. The samples were soaked in boiling water at 100°C for 40 minutes and then dried at 50°C for 18 hours. The samples were dried after removing the fat. The dried chicken feet were soaked in a 0.5% hydrochloric acid solution after removing the mineral salts from them by alkaline treatment. This process was

carried out at 27 ± 1 °C (room temperature) and the solution was changed every three days for a period of 9 to 12 days. The acid treatment was done using acetic acid at a concentration of 0.2% (v/v) for 40 minutes. Final gelatin extraction was performed using distilled water at a temperature of 70°C for 90 minutes at a ratio of 1: 9 (w/v). The extract was filtered using two layers of cheese filter cloth, then dried and ground to obtain the gelatin in its final form. After pre - treatment, the process of extracting gelatin from poultry feet was carried out according to the method [6]. The chicken feet were cut into small pieces and soaked in a sodium hydroxide solution with a concentration of 0.2% (wt/vol) in order to remove the non - collagenous material, and they were shaken. The mixture was stirred at room temperature (22 - 28°C) for 40 minutes. This process was repeated three times until the chicken leg tissue was soft and ready for extraction. After that, the samples were soaked in acetic acid at a concentration of 0.2% (v/v) for 40 minutes. The resulting acidic extract was then dried and washed with running tap water until the pH became neutral, after which the extraction was performed using distilled water at a temperature of 70°C for 90 minutes at a ratio of 1: 9 (w/v) and the extract was filtered using two layers of cheese filter cloth. Pour it into dishes and then dry it in a drying oven at 105°C for 24 hours.

### 2.4. Gelatin yield

Gelatin yield was calculated according the modified method of to the method of Karnjanapratum and Benjakul [8] using the following equation:

$$\text{Gelatin yield} = \frac{\text{Weight of extarcted gelatin (g)}}{\text{Weight of chicken feet (g)}} \times 100$$

### 2.5 pH measurement

The pH of the samples was measured at room temperature using a device (pH meter HI 2211 - pH Meter HANNA) by mixing gelatin powder in distilled water according to the published method of See et al., 2010).

### 2.6 Gel strength

The strength of the gel was determined using the Johnston - Bank method [9], where the resistance to crystallization will be measured in grams using a specific plate to press on the surface of the gel. Gelatin was prepared by mixing dried gelatin with distilled water and leaving the solution at room temperature for 30 minutes. Pre - heating at 65°C for 20 minutes until the gelatin was completely dissolved and then stored at 4°C for 16±2 hours to determine gel strength using a stable micro systems device.

### 2.7 Gel viscosity

Gelatin powder was dissolved in distilled water and heated to a temperature of 60°C, and then the viscosity was measured using a Brookfield digital viscometer with spindle No.1 at a speed of 60 rpm, and a temperature of 40 ± 1°C.

### 2.8 Melting point

The gelatin solution was prepared and placed in test tubes with a screw cap. The samples were tightly closed and stored in the refrigerator at 7°C for 16 to 18 hours. After that, the sample was transferred to a water bath at 10°C and placed upside down inside the water bath so that the temperatures were controlled. The heating process was carried out in stages by increasing the temperature by 1°C per minute, and the melting point of the extracted gelatin was recorded.

### 2.9 Water holding capacity

The water retention property was estimated using the modified method described by Warner [10]. One gram of the extracted gelatin was placed in a centrifuge tube using a device (SIGMA 3K30) and centrifuged at a speed of 920 rpm for 10 minutes. The percentage of centrifuged water was calculated as follows: By subtracting the weight of gelatin after the centrifugation process from the first basic weight (1 g), then the result will be calculated as a percentage.

### 2.10 Color

The gelatin solution was prepared and cooled at 10 ± 1 M O for 18 hours. The color of the gelatin was determined according to the published method using a spectrophotometer (Hunter lab, model 16), and the following colors were obtained (Lightness L*, redness a* and yellowness b*):

### 2.11 Statistical analysis

Statistical analysis was performed for the results obtained with three replicates and for the results of the sensory evaluation with ten replicates for each analysis of the previous tests. The arithmetic mean of the replicates and the significant differences between the treatments were calculated by Duncan's test and detection of the degree of significance at the level of (0.05) analysis of variance (ANOVA) followed by Duncan's Multiple Range Test with $P \leq 0.05$.

## 3. Results and Discussion

### 3.1 Gelatin yield

Table (1) shows the yield of the gelatin extracted from chicken feet. The highest percentage was 3.4% which obtained from the chicken feet of 16 weeks' age and reached followed by 2.7% which obtained in from 14 chicken feet of 16 weeks' age. However, the lowest value of the yield 2.2% was observed in the chicken feet of 12 weeks' age. It was noticed that the yield of the gelatin obtained increased as the age of the chicken increased. The best extraction temperature and time was 70°C for 90 min. It was observed that as the extraction duration increased the yield decreased. The reason for this is that continuing heating for long period of time at high temperatures leads to the breaking of hydrogen bonds and the gel is decomposed, as the duration of extraction and temperature affect the amount of gelatin obtained and its properties [11].

### 3.2. pH

The average pH value of the gelatin obtained ranged from 6.21 to 6.34 (Table 1). The results of the statistical analysis showed that age had no significant ($P \geq 0.05$) difference in the pH values. Soaking the feet in a solution of sodium hydroxide

and acetic acid and repeating the soaking process leads to reducing the acidity in the final products [12].

### 3.3. Gel strength:

The average gel values obtained ranged from 111.16 to 130.21 blooms. There are significant ($P \leq 0.05$) differences in the gel strength values. The values were highly depending on the chicken ages. The highest chicken age gave the highest gel strength value. The highest value (130.21 bloom) was recorded in the control followed by 130.2, 120.8 and 111.2 blooms which observed in gels extracted from chicken legs of 16, 14 and 12 weeks of age, respectively. there was still consistent with the required standards of gel strength, which ranged from 50 to 300 blooms [13].

### 3.4. Gel viscosity

Viscosity is an important physical property in gelatin, as viscosity affects the properties of the gel, especially at the point of gel formation and the melting point. This is due to the increase in temperature which led to the breakdown of the peptidic chains in the gelatin and their transformation into short peptidic chains. The viscosity values obtained were between 6.2 to 7.3. These values are still consistent with the required standards, which range from 6.8 to 7.3 [14].

### 3.5. Melting point:

Table 1 shows the melting point of gelatin for each age, as the average values range from 29.3 to 33.9. The results of the statistical analysis showed that age of the chicken had a significant ($P \leq 0.05$) difference. The highest value was observed in control point followed by the gelatin extracted from the chicken feet of 16 weeks' age. However, there was no significant ($P \geq 0.05$) difference in the melting points values of the gelatin extracted from the chicken feet of 12 and 14 weeks' age, respectively. The reason may be due to an increase in the size of the resulting gelatin grains, and the solubility of gelatin is determined by the ability of water to penetrate through the atoms of the gelatin powder to be more exposed [3].

### 3.6. Gel water holding capacity

The values range from 0.90% to 0.92%, as presented in Table 1 there was no significant ($P \geq 0.05$) difference in the water holding capacity of the extracted gelatin in different gelatins. This finding is in a good agreement with that of Rasli and Sarbon [15], but it was observed that the ability to retain water increased from 0.90 to 0.91% with increasing chicken ages.

### 3.7. Color

**Table 1:** Some parameters measured in the gelatin extracted from different chicken strain feet

| Treatment | Some parameters measured in the extracted gelatin | | | | | |
|---|---|---|---|---|---|---|
| | Percentage of extracted gelatin% | pH value | Gel strength (lbf/100ft2) | Gel viscosity (N. s/m2) | Melting point (°C) | Water holding capacity % |
| Control | NA | $6.5 \pm 0.09^a$ | $138.3 \pm 5.3^a$ | $7.3 \pm 0.9^a$ | $33.9 \pm 0.2^a$ | $0.92 \pm 0.02^a$ |
| 12 week | $2.2 \pm 0.1$ | $6.3 \pm 0.14^a$ | $111.2 \pm 3.1^d$ | $6.2 \pm 0.3^d$ | $29.3 \pm 0.1^c$ | $0.90 \pm 0.10^a$ |
| 14 week | $2.7 \pm 0.2$ | $6.2 \pm 0.02^a$ | $120.8 \pm 3.4^c$ | $6.7 \pm 0.3^c$ | $29.5 \pm 0.1^c$ | $0.91 \pm 0.01^a$ |
| 16 week | $3.4 \pm 0.1$ | $6.2 \pm 0.02^a$ | $130.2 \pm 6.5^b$ | $7.1 \pm 1.3^b$ | $30.4\ 5 \pm 0.2^b$ | $0.91 \pm 0.03^a$ |

Different letters within the columns indicated the significant differences ($P \leq 0.05$)

The color of gelatin depends on the extraction and degree of drying, as the color has no effect on the functional properties of the gelatin, but it has an effect on its acceptance by the consumer [16]. Table 2 shows that there were significant differences ($P \leq 0.05$) in between all obtained color values. The lightest gelatin (L* 80.5) was obtained in the control sample followed by 64.9, 63.1 and 60.7 which obtained in the gelatin extracted from the chicken ibn the age of 14, 15 and 12 age, respectively. The highest redness value (a* 6.1) was observed in the gelatin of the chicken of 12 weeks' age, followed by 14 weeks. The same trend was observed in the values of the yellowness as the highest value of (b* 25.7) at the age of 12 weeks, followed by (b* 22.8) in the gelatin of 14 weeks' age one.

**Table 2:** Color parameters measured in the gelatin extracted from different chicken strain feet

| Treatments | L* | a* | b* |
|---|---|---|---|
| Control | $80.5 \pm 0.7^a$ | $0.2 \pm 0.2^d$ | $16.2 \pm 0.1^d$ |
| 12 week | $60.7 \pm 4.4^d$ | $6.1 \pm 1.4^a$ | $25.7 \pm 0.9^a$ |
| 14 week | $64.9 \pm 6.8^b$ | $3.5 \pm 2.1^b$ | $22.8 \pm 1.1^b$ |
| 16 week | $63.1 \pm 9.6^c$ | $2.5 \pm 1.5^c$ | $19.1 \pm 0.4^c$ |

Different letters within the columns indicated the significant differences ($P \leq 0.05$)

## 4. Conclusion

In concussion, the quality properties of the gelatin extracted from the feet of ROSS chicken were highly dependent on the age of the chicken. The values of the properties obtained in this study could assist the researchers and chicken gelatin producers to choose the correct age of the chicken for gelatin production with correct properties.

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