EXTRACTING, CHARACTERIZATION OF GELATIN FROM OSTRICH BONES AND USE IN SOME FOOD SYSTEMS

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ABSTRACT

The current study focused on producing gelatin from ostrich bone and analyzing its chemical composition. It also studied the physical, chemical, and functional properties. The results indicated that gelatin contained protein, ash, and moisture in percentages of 82.13%, 3.32%, and 14.54%, respectively. Additionally, the gelatin had a high concentration of amino acids, as determined by amino acid analysis. The functional properties of the gelatin were identified using FTIR spectroscopy. The gelatin exhibited a gel strength of 259 g, which falls within the higher gel strength range of 200-300g. Furthermore, gelatin displayed positive values for dl (lighter/darker), da (redder/greener), and db (yellower/bluer). This indicated it had a lighter, redder, and yellower color. It has a pH value of 4.01, while its water holding capacity amounted to 15.24 mL/g, and its solubility was high, as it was 85.22%. Also, the prepared gelatin possessed other functional properties, such as foaming and emulsion capacity. So, it was (87.66, 53.21) %, respectively. Oil binding capacity amounted to 2.65 ml/gm, enabling it to use this gelatin to manufacture various food products to improve functions and develop food good sensory (smell, taste, color, texture, and general acceptance), so the candy evaluation score was very acceptable, as it got scores from (80-100).

Keywords: Functional and Sensory Properties; Gelatin Extraction; Gel Strength; Gummy Candies; Ostrich Gelatin; Physicochemical properties

استخلاص الجيلاتين من عظام النعام وتوصيفه واستخداماته في بعض الأنظمة الغذائية

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المستخلص

ركزت الدراسة الحالية على إنتاج الجيلاتين من عظام النعام وتحليل تركيبه الكيميائي، كما درست الخواص الفيزيائية والكيميائية والوظيفية. وأشارت النتائج إلى أن الجيلاتين يحتوي على البروتين والرماد والرطوبة بنسب 82.13% و3.32% و14.54% على التوالي. بالإضافة إلى ذلك، كان للجيلاتين تركيز عالٍ من الأحماض الأمينية، كما تم تحديده من خلال تحليل الأحماض الأمينية. تم تحديد الخواص الوظيفية للجيلاتين باستخدام مطيافية الأشعة تحت الحمراء. أظهر الجيلاتين قوة هلامية تبلغ 259 غرامًا، والتي تقع ضمن نطاق قوة الهلام الأعلى من 200–300 غرام. بالإضافة الى ذلك، أظهر الجيلاتين قيمًا موجبة لـ dl (أفتح / أغمق)، وda (أحمر / أخضر)، وdb (أصفر / أزرق). وهذا يدل على أنه كان له لون أفتح وأحمر وأصفر. وقد بلغت قيمة الرقم الهيدروجيني له 4.01، في حين بلغت قدرته على حمل بالماء 15.24 مل/غم، وكانت قابليته للذوبان عالية حيث بلغت 85.22%، كما امتلك الجيلاتين المحضر خواص وظيفية أخرى مثل قدرته على الرغوة والقدرة على الاستحلاب فكانت (87.66، 53.21)% على التوالي، وبلغت قدرته على ربط الزيوت 2.65 مل/غم، مما مكنه من استخدام هذا الجيلاتين في تصنيع مختلف المنتجات الغذائية لتحسين وظائفه وتحسين الصفات الحسية (الرائحة، الطعم، اللون، الملمس، والقبول العام)، لذا كانت درجة تقييم الحلوى مقبولة جداً حيث حصلت على درجات من (80–100).

الكلمات المفتاحية: الخصائص الوظيفية والحسية، استخلاص الجيلاتين، قوة الهلام، الحلوى الصمغية، جيلاتين النعام، الخصائص الفيزيائية والكيميائية.

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INTRODUCTION

A significant shift towards more sustainable and natural practices, including additives from natural resources (36, 37, 38). Animal-based proteins such as elastin, collagen, and gelatin play a fundamental role in connective tissue and provide numerous health advantages (6, 39). These proteins are important for sustaining overall health and wellness, and they are essential for a secure and cost-effective food industry (32, 40). Gelatin is a protein derived from collagen, a substance that is abundant in the connective tissues of animals, including bones, cartilage, skin, muscular tendons, and connective tissues. There has been a significant rise in the worldwide demand for gelatin, used in various applications such as the food sector, health goods, cosmetics, biodegradable packaging, and pharmaceutical items (7, 21). Gelatin's unique functional characteristics set it apart from other gel-forming polymers like pectin, agar, and starch. These properties include its ability to undergo thermal gelation and its capacity to melt and solidify multiple times without fracturing. Gelatin is crucial in the gelation and stability of various food products, particularly in the confectionery, dairy, and meat industries. Additionally, due to its unique functional properties, it is employed in the packaging and creating a barrier that provides significant advantages in several industrial applications, including pharmaceuticals, medical supplies, photography, and cosmetics. Due to its numerous benefits, such as affordability, polymerization, biodegradability, and strong antibacterial and antioxidant qualities, it is an excellent choice for food packaging (6, 17, 19). Multiple studies on poultry bone-derived gelatin demonstrate its elevated levels of glycine, hydroxyproline, and proline and its superior thermal stability compared to gelatin sourced from mammals and fish. Chicken gelatin derived from the skin, bones, and feet of chicken is a by-product. It may be removed and utilized in many sectors to mitigate the buildup of poultry waste, which has the potential to cause environmental contamination. Implementing effective waste management practices can result in economic advantages due to the growing demand for poultry products worldwide. The poultry industry is price-competitive and offers high nutritional value. However, many birds are slaughtered to produce poultry meat, and its products generate substantial waste and by-products. This waste contributes to environmental pollution, health hazards, the attraction of flies, and the proliferation of pathogenic microbes. Poultry by-products can be used as an energy source, animal feed, fertilizer, and feed component for soil. Using by-products results in missed opportunities for generating cash and raises the expenses associated with disposal, pollution, and dangers. Waste from the chicken meat sector may be transformed into more valuable goods through recycling (8, 28).

Ostrich bones: One farm produced 1000 kg of ostrich meat per day, and 15-20% of the bone remains based on the body weight of the ostrich (180-300) kg. Therefore, the researchers recommended recycling waste from ostrich bone and reusing it to produce products of significant value, which is vital for multiple uses in various industries such as biomedical applications and dentistry (5,20). The global demand for gelatin in the sector is increasing, especially in the food and pharmaceutical industry. The raw materials for the production of gelatin are pig skin (42.4%), cowhide (29.3%), bovine bone or pig bone (27.6%), and other materials of fish and lamb skin (0.7%). This indicates that the production of gelatin comes primarily from pigs, which is forbidden to be eaten by Muslims. Chicken bone gelatin could be one of the alternatives to meet the demand for healthy and halal food in Islamic countries. In addition to the halal issues, there are health concerns associated with gelatin in mammals and fish gelatin with allergic reactions. Potential new gelatin sources such as poultry skin, feet, and bones have risen to replace mammalian resources (33, 34). This study seeks to demonstrate the viability of using gelatin derived from ostrich as a substitute for imported gelatin, which currently requires hard currency. Furthermore, this exporting country mainly depends on making gelatin from pig products, which is strictly prohibited in our Islamic religion. Additionally, there is an economic advantage in producing gelatin from chicken waste,

namely ostrich bones and incorporating it into certain food systems

MATERIAL AND METHODS

Raw material

The bones of ostriches were acquired from farms in the Babylon Governorate, namely in the Mahawil District. The items were cleansed, and the fat portions were separated and preserved in a freezer at a temperature of -18 degrees Celsius until needed.

Gelatin extraction from ostrich bones

Gelatin was extracted from ostrich bones according to the method followed by (29) with modification. The bones were cut into small pieces using an electric saw. Then, washed well with running water, then treated with 0.5 M NaOH solution and stored for two hours. It was then filtered using a muslin cloth and treated with 10% butyl alcohol to remove fat. The defatted sample was then treated with HCl (2 N) solution (1:6 w/v) and stirred continuously for 24 h to remove inorganic compounds followed by filtration and washing with tap water. The sample was then treated with a 4.5% lactic acid solution (1:1), placed for several hours, and heated (55°C) in a water bath (20 minutes) to extract gelatin. The post-incubation sample was filtered using amoslin cloth and then using filter paper (Whatman, 4) with a Buchner funnel, and the filtrate was collected for drying in the Freeze Dryer.

Chemical content of gelatin

The methods described in (25) were used to determine moisture, protein, and ash.

Amino acid analysis

Analyzed in ostrich bone gelatin was the amino acid content using the procedure detailed in (10). put 3 milliliters of hydrochloric acid (6 M with 0.1% w/v phenol) to a 10 milliliter headspace glass vial with a crimp cover after weighing out around 5 milligrams of the material. After sealing the vial, it was heated in an oven at 110 °C for 24 hours. Following hydrolysis, the samples were cooled to room temperature. Subsequently, 3 mL of sodium hydroxide (6M) was added to neutralize them. The mixture was carefully mixed, and the samples were again allowed to cool to room temperature. “After cooling, an aliquot was filtered through a 0.45 µm, 13 mm diameter nylon filter. Measurement was done using a device Amino acid analysis under conditions Mobile phase, acetonitrile: buffer (30: 70), injection program, including derivatization steps with OPA, injected volume (100) uL, Column: ZORBAX Eclipse-AAA; 3.5µm; L x i.d.=150 x 4.6 mm, Detector: fluorescence (Ex = 360 nm, Em = 450 nm)”.

Gel Strength Determination

The gel strength was measured according to the method mentioned in (1). It is one of the most important measurements used to evaluate the degree and quality of an aqueous gelatin solution consisting of 6.67% gelatin (7.50 g gelatin and 105 ml deionized water, dissolved at (60-65 ° C). Prepare it carefully in a marked 150 mL, wide-mouth glass vial, then place it in a chilled water bath and keep it at 10 °C for 17 hours. After cooling, the hardness of the gel was measured as the required force in g. Impress a standard piston of 0.500-inch diameter to a depth of 4 mm into the gel surface. This weight is called gel strength or Bloom's rating for gelatin. The higher the strength required, the stronger the gel. Bloom resistance was measured using a Brookfield CT3 Analyzer, USA, with a 12.7 mm cylindrical flat surface and sharp edge probe (AAC standard for bloom test). The speed was set at 1 mm/sec with a 5 mm distance objective.

FTIR analysis of gelatin solutions

Attenuated Fourier Transform Infrared (ATR-FTIR) spectroscopy was used to study the effects of hydration on gelatin in terms of molecular and supramolecular structure and the organization of the secondary structure of gelatin according to the working method mentioned in (14).

Colorimetry

The color was measured by color capture software on a Xiaomi 12 pro 5G smartphone running Android 13 and MIUI 14. Whiteness (L*), redness (a*), and yellowness (b*) were measured, according to (35), and for three different locations to determine the average values of L*, a*, and b* during the measurements.

Estimation of pH values

To determine the pH of ostrich bone gelatin, we followed the steps outlined in reference (4). First, we made a 1% gelatin solution in distilled water. Then, we heated the mixture to

45 °C for 5 minutes to dissolve the gelatin. Finally, we let it cool to room temperature before taking the pH reading with a pH meter.

Water holding capacity

To find the water-holding capacity, we followed the steps outlined in reference (3, 23) and mixed 0.5 g of gelatin with 20 ml of water, then agitated it with a magnetic stirrer for 1 minute. After being mixed well, the solution was moved to a centrifuge tube and left to sit at room temperature for six hours. After that, it was spun at 2,800 × g for thirty minutes. The volume recovered was determined after filtering the supernatant with What Man No. 1 filter paper. The volume of the supernatant was used to calculate the difference between the original quantities. This was then represented as milliliters of water absorbed per gram of gelatin sample.

WHC (ml/gm)= Vw – Vs / Wg …..(1)

Where WHC= Water holding capacity

Vw = Initial volume of distilled water

Vs = Volume of supernatant

Wg = One gram of gelatin

Functional properties: After dissolving gelatin in distilled water to a concentration of 2% (wt/vol), 5 ml of the resulting solution was transferred to a glass test tube in order to assess its solubility, as described in reference (27). They went on to change the pH from 2 to 12. While keeping the pH of the sample under analysis, mix 1 M NaOH with 10 ml of distilled water to make a complete solution—centrifuge at 9,000 x g for 10 minutes at room temperature. A Biuret test was used to evaluate the sample's protein concentration both before and after centrifugation (30). A measure of gelatin's solubility was the ratio of the protein content of the supernatant to that of the starting sample. The foaming properties were measured by preparing a gelatin solution with a concentration of (1%) according to the method described in (16) oil binding capacity according to (18).

FC = Vaw – Vbw / Vbw …….(2)

Where FC = Foaming capacity

Vaw = Volume after whipping

Vbw = volume before whipping

FC = Vas – Vbw / Vbw …….(3)

Where FC = Foaming capacity

Vas = Volume after standing

Vbw = volume before whipping

Oil binding capacity (mL/g) = (V1- V0) / W ….. (4)

Where V0 and V1 are the volumes of initial oil and free oil, respectively ,

W= is the weight of the sample

Oil binding capacity (mL/g) = (V_1- V_0) / W…….(5)

Where V_0 and V_1 are the volumes of initial oil and free oil, respectively,

W= is the weight of the sample

The emulsion capacity (EC) and emulsion stability (ES) of gelatin were determined by the method reported in (8).

EC = (HEW/ HWL) ×100 …… (6)

Where EC= Emulsion capacity

HEW = Height of emulsion layer whipping

HWL= Height of whole layer

ES = (HELa / HWL) ×100……(7)

Where ES= Emulsion stability

HEla = Height of emulsion layer after heating

HWL= Height of whole layer

Use of gelatin powder in food systems

Gummy candies were made with ostrich bone gelatin in a way with some modification (9), pectin (1.7 g), sucrose (330 g), glucose syrup (480 g), water (320 ml), gelatin (50 g), and flavorings. The exponential value was adjusted with 25 ml of citric acid (50%). pH to 3.2-3.4. Before mixing the pectin with 100g of sugar, the gelatin was expanded in water. Stirring with 200ml water and boiling dissolved the pectin. Add the remaining sugar and glucose syrup and boil. Then, a magnetic stirrer on a heated plate dissolved the enlarged gelatin in water. The sugar-pectin combination received gelatin, color, and taste. We increased the pH to 3.2-3.4.

Sensory examinations of gummy candies

Sensory evaluation of odor, flavor, color, texture, and overall acceptability (20, 40, 10, 20, 10) degree was carried out according to (9)

RESULTS AND DISCUSSION

Chemical Content of Gelatin: The results in Table (1) indicate the chemical content of gelatin prepared from ostrich bones. It was noticed that gelatin contains 82.13% protein ash and moisture, which is 3.32% and 14.54%, respectively.

Table 1. Chemical content of gelatin prepared from ostrich bones

Moisture	Ash	Protein
14.54	3.32	82.13

The results converged with (24). They found that the percentage of moisture and ash in gelatin chicken amounted to 12.5% and 4.52%, respectively. The chemical content of gelatin may change according to several conditions, including the age, type, and sex of the animal or depending on the feeding method used during breeding. Age is considered one of the most critical factors affecting the chemical content of bones.

Amino acid content

The results in Table (2) show the amino acid content of gelatin prepared from ostrich bone. Amino acids included the presence of (lysine, methionine, tryptophan, arginine, threonine, valine, isoleucine, leucine, phenylalanine, glutamic acid, aspartic acid, histidine, serine, proline, histidine). It reached (127.3, 102.33, 124.56, 142.05, 62.15 ,113.69 ,104.58 ,89.57 , ,108.97 ,130.25 ,125.49 ,107.45 125.69, 104.55, and 117.58) mg/g, respectively. The results were greeted with (13) who determined the amino acid content of gelatin extracted from the chicken bone.

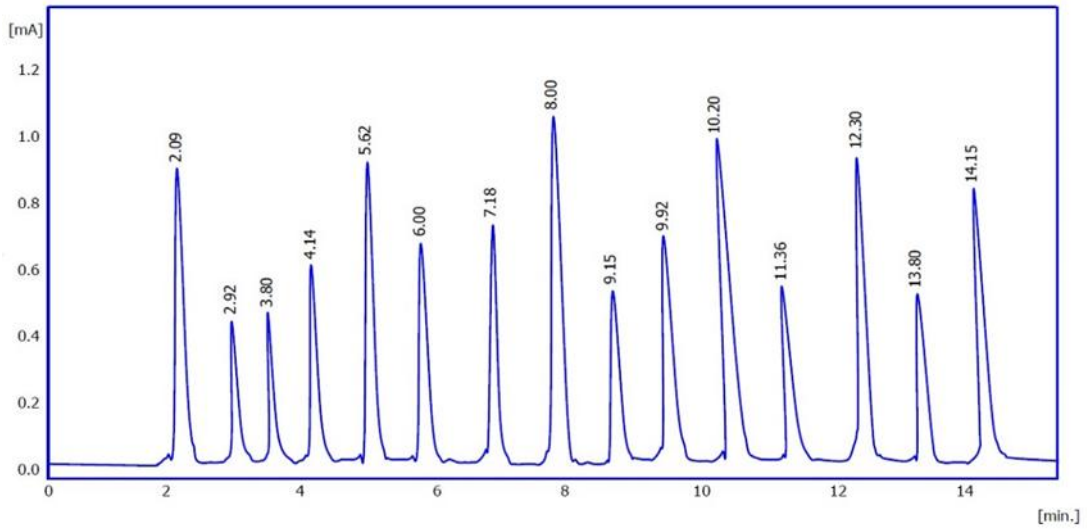

Figure 1. Amino acid profile in ostrich bone gelatin

Table 2. Amino acid content of gelatin prepared from ostrich bone

	Amino acid	Reten.Time [min]	Area [mAU.s]	Amount [µg / gm]
1	Lysine	2.09	4265.89	127.3
2	Methionine	2.92	1265.88	102.33
3	Tryptophan	3.80	1426.98	124.56
4	Arginine	4.14	2478.14	142.05
5	Threonine	5.62	3652.09	62.15
6	Valine	6.00	3698.79	89.57
7	Isoleucine	7.18	4526.47	104.58
8	Lucien	8.00	3204.88	113.69
9	Phenylalanine	9.15	4257.84	107.45
10	Glutamic acid	9.92	6321.47	125.49
11	Aspartic acid	10.20	4215.01	130.25
12	Histidine	11.36	2995.08	108.97
13	Serine	12.30	3568.70	125.69
14	Proline	13.80	3254.88	104.55
15	Cysteine	14.15	2470.56	117.58

Fourier-transform infrared

See Figure 2 for the FTIR spectra of the gelatin sample. FTIR analysis is a powerful tool for determining the functional groups and secondary structures of gelatin. FTIR analysis of a sample of gelatin prepared from ostrich bone showed the most critical peaks appearing in the spectrum of gelatinous materials, assigning each peak to the relevant active group in the compound, as the wide band was observed in the region 3309.25 cm^{-1} 3473.17- cm^{-1} in the gelatinous substance of this study. This is due to the amplitude oscillation of the O-H hydroxyl groups and the N-H amino groups intertwined with the hydroxyl groups; peaks appear in the amide regions as amide

(A, I, II, III) appears. The amide-A band is due to the expansion of the NH vibrations, which indicates a coiled gelatinous structure, where the expansion of the vibrations of the free NH group is generally observed at 3309.25cm-1-3473.17cm-1. Protein secondary structure research in the infrared spectral range benefits from these vibrations. Because of structural patterns that distort the NH1 of the peptide group, the amide II peaks in the gelatin sample are thought to be caused by out-of-phase CN stretching. Amide III, on the other hand, suggests gelatin molecule disruptions and may be associated with the absence of the triple-helical structure. The results are consistent with what was found in (31). As for the beam at the 2922.59 cm-1 region, it is due to the amplitude oscillation of the aliphatic C-H group and the presence of a peak at the 1453.1 cm-1 region due to the bending vibration of the aliphatic C-H group, which is the same beam obtained by (26). As for the beam at the location 1657.52 cm $^{-1}$, it is due to the amplitude oscillation of the C = O group, and its appearance in a broad form is due to hydrogen bonding with N-H, and it is consistent with what (12) found. The band at 1243.86 cm-1 is due to the amplitude oscillation of the C-O group. It was also observed that values appeared at the 1081.87 cm-1 site due to the amplitude vibration of the C-O bond, as it seems clear in some gelatin prepared from chicken legs and bones, while it is not clear in the materials extracted from fish skin.

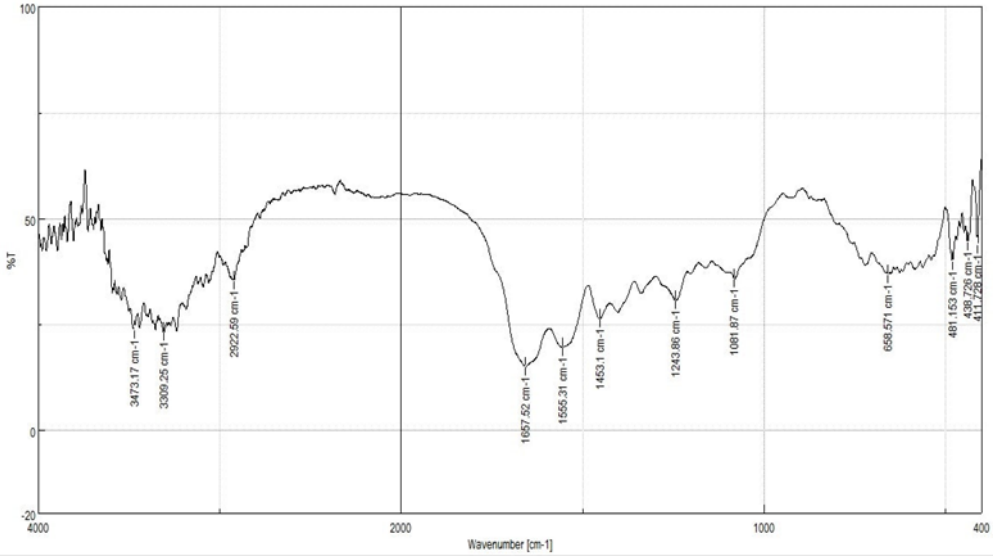

Figure 2. FTIR analysis of Gelatin

Gel strength of gelatin

According to FTIR studies, gelatin greatly aids in the development of hydrogen bonds with water molecules, leading to the formation of stable three-dimensional gels—a crucial feature of gel strength in the food industry. Classification of gelatin gels (6.67%) according to gel strength is common practice; for example, there is a greater bloom strength range of 200-300g, a medium bloom strength range of 100-200g, and less bloom strength range of 50-100g. The food and pharmaceutical industries make extensive use of the diverse gelatinizing properties. Gelatin is used to produce soups, sauces, and meals to impart a smooth consistency. It is also used in low-fat spreads to act as a binding agent. Gelatin hydrolyzate has also been incorporated into various energy drinks for athletes (24). The flowering/gel strength values of gelatin prepared from ostrich bone were 259g. The higher bloom/gel strength values in bone gelatin may be attributed to the higher proline and hydroxyproline content, which impart stability to the gelatin structure through hydrogen bonding.

Physical properties

Color, pH, and water holding capacity: Table (3) displays the color values of the gelatinous gels obtained from ostrich bones. The color value is dependent on the raw materials and the circumstances of extraction; however, the functional qualities of the gelatin are unaffected by this color feature. However, it influences the level of approval from buyers. Color is characterized by L ∗, a ∗ , and

b∗values, as the illumination value was the highest (L ∗) and amounted to 46.76, while the values of a ∗ and b∗ were the lowest, amounting to -1.7 and 19.31, respectively. The pH value of gelatin is a crucial determinant of its quality. According to Table (3), the pH value of gelatin is 4.01. The pH value of gelatin is a good value close to the value of neutral pH, and the result agreed with what (5) studied when extracting gelatin from Chicken bones, using hydrochloric acid at a concentration of 2%, as the pH value of the prepared gelatin was 4.14. The ability of proteins to absorb and retain water, often known as their water-holding capacity, is a crucial component of their functional qualities in the food system. Protein structure and the quantity of hydrophilic amino acids determine the protein's water-holding capacity. Table (3) shows the value of the water-holding capacity of gelatin prepared from ostrich bone, as it amounted to 15.24 mL/g. The results agreed with (24) when preparing gelatin from chicken feet, who found that the water holding capacity value was 14.3 mL/g.

Table 3. Physical properties of ostrich bone gelatin

Physical properties of ostrich bone gelatin				
pH	**WHC mL/g**	**Color**		
		L ∗	**a ∗**	**b∗**
4.01	**15.24**	**46.76**	**-1.7**	**19.31**

Functional properties

Solubility: According to Table (4), the solubility value of gelatin was 85.22%. The high solubility of gelatin may be due to its high percentage of hydrophilic amino acids. This feature is also essential because it reflects the functions and behavior of proteins in meals. Protein thawing also serves as a guide for other properties like foaming, emulsification, and gelation. At a pH of 4, the foaming capability of ostrich bone gelatin was comparable to that of chicken head gelatin, as determined by (22). The percentage was highest at this pH compared to Turkey's head bone at a pH higher than 4. The reason for this is that the use of acid during the extraction of gelatin type (A) did not impact the composition of the amino acids in the original collagen. However, when the base was used to prepare gelatin type (B), glutamine and asparagine were transformed into glutamic acid and aspartic acid, respectively. This resulted in a shift in the isoelectric point towards lower pH values.

Foaming capacity and stability of gelatin

The foam capacity is expressed as the maximum volume that can be obtained from the spread of the protein, followed by the introduction of air by whisking or stirring. Its stability means it can retain the maximum volume during a specific period. It was noted that ostrich bone gelatin could form foam. It was shown in Table (4) that it reached 87.66% because gelatin has a remarkable ability to form foam by enhancing the viscosity of the aqueous phase and thus reducing the interface surface tension between water and air, and also gelatin possessed a high foam stability, reaching 85.81% “due to the presence of a high percentage of hydrophobic amino acids such as proline at a rate of 104.55 µg / gm”. This study agreed with what (24) found in his research when preparing gelatin from chicken feet and heads, as the foaming capacity reached 81.5% and 75.62%, respectively. The foaming stability of the aforementioned gelatin in the same study amounted to 79.44% and 71.28%, respectively.

Fat binding capacity

The ability to bind fat is a functional property closely related to food texture and other critical nutritional characteristics. The high ability of proteins to bind fat is due to the nature of the size of protein particles and to the hydrophobic surface forces, as Table (4) shows the amount of fat absorbed by gelatin as it reached Its value of 2.65 ml/gm, and the high ability of gelatin to bind fat leads to an increase in its ability to retain flavoring materials because they are usually dissolved in fat and thus increase its acceptance. This property is of great importance in processed foods. The ability to bind fat for ostrich bone gelatin in this study agreed with (11) when estimating the ability of gelatin prepared from chicken waste to bind fat, reaching 1.6 ml / g. In contrast, the (15) “Fat binding capacity of gelatin is 5.3 mL/g”. As for (2), the ability of

gelatin to bind a lipid ranged from 2.5 to 4.4 ml/g. The difference in the ability to bind a lipid may be due to the difference in the amount and type of non-polar residues of proteins and the degree of susceptibility to these hydrophobic residues, which are associated with the side chain hydrocarbons for oil values.

Table 4. functional properties of ostrich bone gelatin

functional properties of ostrich bone gelatin						
gel strength g	Gelatin solubility %	Foaming capacity %	Foaming stability %	Emulsion capacity %	Emulsion stability %	Oil binding capacity mL/g
259	85.22	87.66	85.81	53.21	52.36	2.65

Emulsifying capacity and stability

To evaluate how well protein materials work in food emulsions, scientists look at their emulsifying capabilities. This is because proteins play a key role in keeping a fat-in-water emulsion stable by reducing surface tension by occupying a space between the surfaces of the fat and water. Thus, they are attracted to the polar (water) and non-polar (fat) phases. Table (4) shows the ability of gelatin to form an emulsion, as its value amounted to 53.21%. As for the emulsifying stability of gelatin, it amounted to 52.36%. Emulsifying capacity and stability of ostrich bone gelatin in this study are consistent with (7) found in their research that the emulsifying ability "of gelatin extracted from the skin and bones of poultry at five different temperatures (40 ° C, 45 ° C, 50 ° C, 55 ° C and 60 ° C) in the skin was 43.70, 48.73, 47.77, 46.90 and 45.33%, respectively". And in the bones 36.53 and 43. 73, 39.63, 38.57, and 37.07%, while it was found that the emulsification stability in the skin was 41.27, 47.20, 45.20, 43.23, and 42.77%, respectively, and in bone, 27.37, 31.53, 29.93, 29 and 28.30%.The use of natural emulsifiers rather than synthetic ones is becoming more common in the food sector. The emulsifying, stabilizing, and producing of desired physical and chemical characteristics are all benefits of using proteins derived from a variety of natural sources as emulsifiers in food.

Sensory evaluation of gummy candies product made from ostrich bone gelatin

The unusual functional qualities of gelatin made it a popular ingredient in gummy candies. Table (5) shows sensory evaluation scores for candy made from gelatin prepared from ostrich bone and compared with candy made from commercial gelatin. The Table shows that the candy made from gelatin prepared from ostrich bone is acceptable. It got degrees between (80-100) as it was found that the difference in the evaluation of each of the odor, taste, color, texture, and Overall acceptability was different from the degrees of the assessment of the candy made from commercial gelatin.

Table 5. Sensory evaluation (odor, flavor, color, texture, Overall acceptability) of a product gummy candies made from ostrich bone gelatin

Sensory qualities	The product prepared from bone gelatin*	The product prepared from commercial gelatin
Odor	17.3	16.6
Flavor	32.2	31.5
Color	8.2	8.5
Texture	14.6	14.1
Overall acceptability	9.8	9.3
The total	82.1	80.0

80-100 Very acceptable
Ns* = Not significant

Sensory evaluation of gummy candies made from ostrich bone gelatin in this study agreed with (2) when making diamond sweets from gelatin from the bones of birds, cows, and sheep, as the gelatin was prepared from acidic treatments with different sources. It is considered the best type of gelatin used to manufacture sweets. Many studies introduced gelatin from bird bones into various food industries (35). They mentioned the possibility of producing chocolate custard from gelatin prepared from chicken bones and prepared by acid treatment when extracted from them. It is possible to produce gelatin from ostrich bone, a by-product, by using 2% concentration of

acid HCL. The resulting gelatin has high protein content, making it highly nutritious. It can be incorporated into food systems due to its functional properties and nutritional value. Additionally, gelatin can be used as a thickener, gel, and binder in various food industries due to its essential functional characteristics. The gelatin acquired in this investigation has characteristics comparable to gelatin derived from mammals. It is suggested as a substitute for mammalian gelatin, possibly in candy/jelly-based items in the food business. Furthermore, similar to its equivalents derived from cows and pigs, it may also serve as a packaging material for drugs or chemicals in the biomedical industry, owing to its close resemblance to gelatin found in animals.

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