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# Studying Chemical Composition of Myofibril and Sarcoplasmic Proteins Separated From Different Types of Meats

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## Abstract

The present study was dealt with the estimation of the chemical composition (moisture, protein, fat, and ash) and physical properties (pH and water holding capacity) of camel, duck, and tuna meat purchased from local markets. Muscle proteins were separated, including myofibril and sarcoplasmic proteins from these meats, estimation of the yield and study of their content. have been studied. the results were as follows:

1. Statistical results disclosed that there was a significant difference at a probability level ( $P \leq 0.05$ ) in the percentage of moisture, protein, fat, ash, pH, and values of water holding capability in each of camel, duck, and tuna's meat.
2. Statistical results made a clear reference that there were significant differences at a probability level ( $P \leq 0.05$ ) in the percentage of yield, moisture, protein, fat, and ash of myofibril and sarcoplasmic proteins in each of camel, duck, and tuna's meat. Also, a dual interference between meat type and protein type was significant in its impact on percentages of yield and chemical composition.
3. It was observed the percentage of moisture and fat in tuna meat was higher than the percentage of moisture in duck meat. As to the lowest percentage of moisture, it was in the meat of tuna, while the tuna meat recorded the highest percentage in protein and ash, then followed by the percentage of protein and ash in duck meat, while camel's meat recorded the lowest percentage of protein and ash. Besides, results indicated that the values of pH and water holding capability of duck meat were higher than that in the meat of tuna meat and camel.
4. It was found that the percentage of the yield for proteins of a myofibril of duck meat was higher than that in the meat of tuna and camels, as the percentage of yield of sarcoplasmic proteins for tuna was higher than that in the meat of duck and camels.
5. It was found that the percentage of yield for myofibril of duck meat was higher than that in the meat of tuna and camels. As to the percentage of yield for sarcoplasmic proteins of tuna meat, it was higher than that in the meat of duck and camels.
6. The highest percentage of moisture for myofibril proteins was in the meat of camels, and the lowest percentage of it was registered in myofibril proteins in tuna meat, whilst the highest percentage of moisture for sarcoplasmic proteins was registered in the meat of duck, and the lowest of it registered in sarcoplasmic proteins in tuna meat.
7. It was observed that the highest percentage of protein and fat for myofibril and sarcoplasmic proteins was registered in tuna meat, as the lowest percentage of protein and fat for myofibril and sarcoplasmic proteins were observed in duck meat.
8. The study came up with a result revealing that the percentage of ash in proteins of myofibril proteins for duck meat was higher than that in myofibril proteins for camels and tuna meat, whilst, the percentage of ash in sarcoplasmic proteins for camel meat was higher than that in sarcoplasmic proteins for duck and tuna meat.
9. Results showed that the highest concentration of sarcoplasmic proteins was in tuna meat, followed by duck meat, and the lowest concentration for these proteins was in camel meat. The values of proteins (myosin, tropomyosin, reticulin, and collagen) in camel meat, then followed by duck meat, whilst the lowest values for these proteins were in tuna meat.

Keywords: Chemical content, Physical properties, Myofibrillar proteins, Sarcoplasmic proteins.



## 1. Introduction

The term “meats” includes many types of meat such as cattle meat (cows, sheep, goats, camels, and others), birds’ meat (geese, turkeys, chickens, ostriches, and others, and different types of fish which are considered one of the best categories of meat. Different types of meat, of miscellaneous sources, are complete nutrition material due to its content of high nutritional values, containing all basic amino-acids that the body cannot create as well as fats entering in the composition of hormones controlling the level of blood sugar percentage, and mineral elements such as calcium, phosphorous, iodine, sulfur, copper, iron, fluorine, cobalt, zinc and other minerals, as well as being a source of the B - complex vitamins [1,2].

Proteins of meat muscles contain myofibril and sarcoplasmic proteins and proteins of connective tissues that enhance support, and repair damaged body tissues [3].

Reliance on meat as a source of protein is considered one of the important issues in the nutrition system for the treatment of malnutrition issues related to health due to its content of significant nutrients[34]. Good nutrition enhances human life via the bioavailability of necessary nutrients in their daily meals and ensures family individuals enjoying good health [4].

Proteins are vital nutrients for the human body such as fats, carbohydrates, vitamins, and minerals, which are required in huge quantities because these nutrients compose a basis for bodybuilding and are necessary for all bioactivities, and then converted to proteins having a role in organs and systems activities[5]. The basic source for protein abundance is meat, of all types.

The aim of the research: The present study aimed to evaluate the chemical composition and physical traits of meat types (camels, duck, and tuna). Then myofibril and sarcoplasmic proteins were separated from these meats. Also, the study aimed at studying their yield and chemical content.

## 2. Materials and Methods

### 2.1. Materials

#### 2.1.1. Camel meat

Camels were purchased from the Holy governorate of Karbala local markets age ranged (1-1.5) year. Animals were slaughtered at 6 am. Meat samples were collected from the thigh (5 kg). Samples were placed in plastic containers, mixed with crushed ice, and transported to the laboratory for analysis.

#### 2.1.2. Ducks meat

Ducks, of an Arab type, were purchased from the local markets of Basra governorate. The ducks were about (2.5-3) months old. The skin was removed, and ducks were cleaned at home and cut into pieces. After cleaning, the ducks were weighed at about (1-1.3 kg). Samples of meat taken from thigh and chest areas were minced using a mincing machine and mixed. Samples were placed in plastic containers, mixed with crushed ice, and transported to the laboratory for analysis.

#### 2.1.3. Tuna meat

The meat of tuna fish was purchased from the local markets of Basra Governorate. Following the removal of its skin and cleaning accomplished at home, it was cut into portions whose weight ranged from (1-2.4 kg). The samples were brought to the laboratory after being placed in plastic containers mixed with crushed ice.

### 2.2. Methods

#### 2.2.1. Extraction of myofibrillars and sarcoplasmic proteins

Muscle tissue proteins and sarcoplasm proteins are separated separately, as proteins differ in their solubility in saline solutions so this characteristic is used to separate proteins from the raw material and this is done by adding a sufficient amount and with a specific concentration of salts that are usually ammonium sulfate or sodium chloride or sodium chloride or potassium. Many proteins are deposited, which are separated by centrifugation, and another amount of salt can be added to deposit the protein to be purified [6] and Pivoted method of [7] in muscle fiber proteins separation.

1. The meat was cut and finely chopped.
2. 200 g of minced meat was taken.
3. The minced meat is mixed with a NaCl 1% saline solution in a 2: 1 ratio (meat: a saline solution) with an electric mixer.
4. A centrifuge is discarded at a velocity of 5,000 cycles/minute for half an hour, and the precipitate represents the muscle fiber proteins and the leaky represents the sarcoplasm proteins.
5. The sediment was emptied by the Vacuumed Oven at 55 ° C.
6. After drying, the precipitate was ground with a ceramic mortar to soften it, and then it was kept in the refrigerator at  $7 \pm 2$  ° C until use.
7. The filtrate was rotated with the Rotary Vacuum Evaporator at 50 ° C and was freeze-dried and stored in the refrigerator at  $7 \pm 2$  ° C until use.

### 2.2.2. Separation of Muscle myofibril, sarcoplasmic and Connective tissues proteins of meat (Camels, Ducks, and Tuna) by the chemical method:

First, thigh meat proteins were separated according to the method described by [8], modified by [9], which included preparation of standard solutions of glycerol at a concentration of 2% and a solution of KCl at a concentration of (0.3 M), to which a phosphate buffer solution (0.1 M) was added. Then, at a pH of 6.5 and a KL solution was added, at a concentration of 0.6 M, a buffer is added to it at a concentration of (0.1 M) Tris, and at pH 7.2, a solution consisting of chloroform and methanol in a ratio of (3: 1), and a solution of lactic acid, at a concentration of (0.1 M).

Then (10 g) of the delicately chopped sample was weighed and treated with glycerol solution for (90) minutes at a temperature of (2°C). Following this step, a centrifugal process was carried out at a speed of (4600 rpm) for (60) minutes, and the purified liquid, representing the sarcoplasmic protein was separated, while the deposit represented the rest of the myofibril and connective tissue proteins. This deposit was treated with a KCl solution and maintained for (90) minutes at (2°C).

Then centrifugation was conducted for 60 minutes, and the purified liquid representing the myofibrillar proteins, which is mainly Myosin, was separated. As for the remaining deposit, it is extracted three times with KI solution and maintained for (90) minutes at a temperature of (2 °C). Centrifugation is carried out for the deposit at the same speed and duration. The purified liquid that represents the tropomyosin protein is separated. The deposit represents the stroma complex along with fat washed with distilled water, then treated with chloroform and methanol solution. A centrifugal process was conducted for the deposit at (4600) rpm for (15) minutes. Later, the deposit, which represents the dissolved fats, was discarded. The deposit was treated with a lactic solution, and maintained for (90) minutes, at (2 °C). Then, the deposit was centrifuged as in the previous steps, where the deposit represented the Reticulin protein, and the deposit represented the Collagen / Elastin complex. In the end, the protein concentration in the separated proteins was measured. According to the Biuret method cited [10], and mentioned [11], as shown below:

- Solutions Used:

1. Bovine Serum Albumin (BSA):

Prepared by dissolving (0.05) g of bovine serum albumin in an amount of distilled water, and then complete the volume to (10) ml, (Solution No. (1)).

2. Biuret Solution:

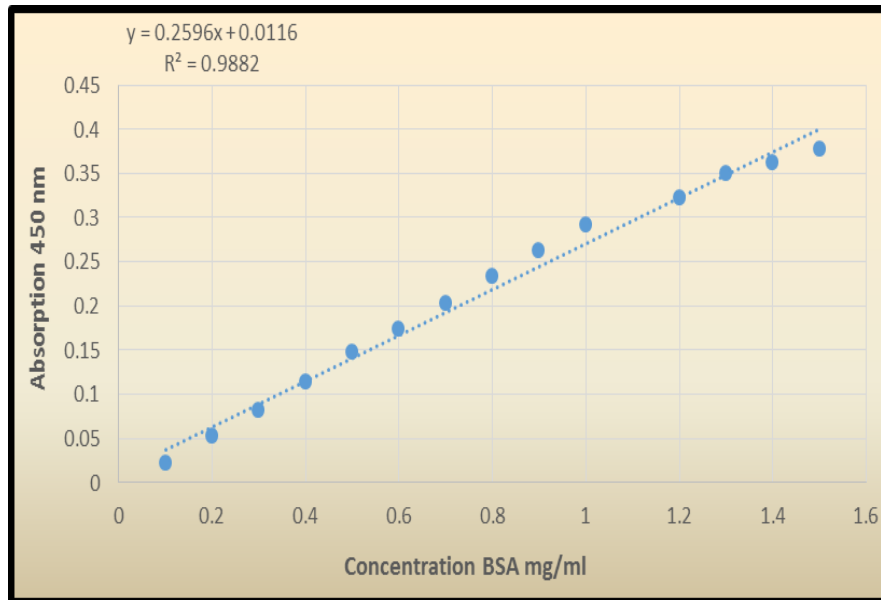
Prepared by dissolving (1.9) g of aqueous copper sulfate  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  in (500) ml of distilled water, adding (6) g of potassium sodium tartrate  $\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$  with (2) g of NaOH, and the volume was filled to 1 liter, then maintaining the solution in an opaque container at temperature (4°C) until the time of use, (Solution No. (2)).

3. KOH Potassium Hydroxide (20%):

It was prepared by dissolving (200) g of KOH in (1) liter of distilled water, (Solution No. (3)).

- Methodology

First of all, the standard curve for bovine serum albumin was prepared from solution No. (1) (0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 1.2, 1.3, 1.4 & 1.5) mg/ml in test tubes. Second, size of (0.5) ml of solution No. (3) was added to each tube. Third, the tubes were left for (10) minutes at laboratory temperature, then (1.5) ml of solution No. 2 was added to each tube, and left for (15) minutes at room temperature. Later, the absorbance of the tubes was read at a wavelength of (540) nm, as shown in figure (2).



**Figure 1.** Standard Curve for Bovine Serum Albumin.

### 2.2.3. Chemical Composition

- Moisture Estimation

The percentage of moisture was estimated according to the method mentioned [12] for different fresh meat samples and separated myofibril and sarcoplasmic proteins.

- Ash Estimation

The percentage of ash was estimated according to the method mentioned [13] for different fresh meat samples, for separated myofibril and sarcoplasmic proteins.

- Protein Estimation

Total nitrogen was estimated in the sample and multiplied by the protein conversion factor (6.25) [14] and in all fresh meat samples taken from the three animal species, as well as in myofibril and sarcoplasmic proteins.

- Fat Estimation

The percentage of fat was estimated after extracting it with the Soxhlet device and using the organic solvent, chloroform, at its boiling point (40-60) °C for (16) hours [15] for all fresh meat samples as well as for myofibril and sarcoplasmic proteins.

### 2.2.4. Physical Properties

- Yield

The percentage of a yield of myofibril and sarcoplasmic proteins were calculated according to [16].

$$\text{Yield} = \frac{\text{weight of separated protein} \times 100}{\text{weight of meat}}$$

- pH

The pH was measured after mixing (5) g of the sample with (10) ml of distilled water according to the method adopted by [44] for different fresh meat samples.

- Water Holding Capacity (WHC)

The Water Holding Capacity was measured by taking (10) g of minced meat and adding (20) of distilled water to it. The sample was mixed well to obtain a homogeneous mixture using an electric mixer. Then the contents were transferred to a graduated cylinder at the end of which was a funnel and filter paper No. (1). The filtrate was received, and its size was registered after (30) minutes [17].

$$\text{Water Holding Capacity (ml)} = \text{total water quantity (ml)} - (\text{water quantity in a graduated cylinder (ml)})$$

### 2.2.5. Design and Statistical Analysis

The data were statistically analyzed using Complete Randomized Design (CRD) within the ready-made Special Program for Statistical (SPSS) (2016), using a one-factor and two-factor experiment. Then the studied factors were tested using the least significant difference test LSD at the probability level (0.05) according to [18].

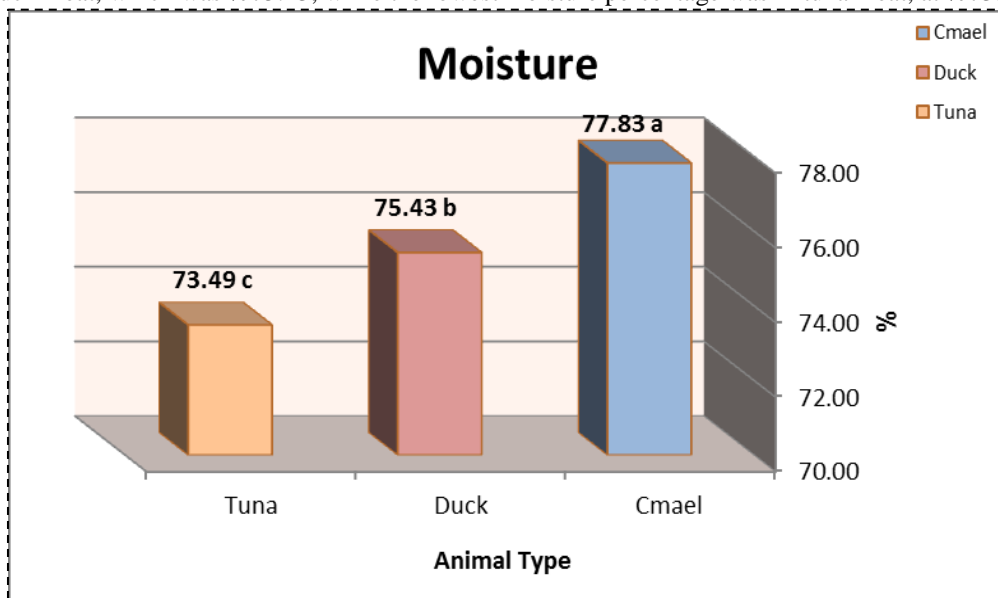
## 3. Results and Discussion

### 3.1. Chemical Composition of Meat

#### 3.1.1. Moisture

As to the percentage of moisture in camel, duck, and tuna meat, figure (2) made it clear that there were significant differences at the probability level ( $P \leq 0.05$ ) in the percentage of moisture in camel meat, duck meat, and tuna meat.

The said figure disclosed that the moisture percentage in camel meat was %77.83, which is higher than the moisture percentage in duck meat, which was %75.43, while the lowest moisture percentage was in tuna meat, at %73.49.



**Figure 2.** Impact of Meat Type (Camel, Duck & Tuna) on the Moisture Percentage

All results mentioned in the table are an average of three replicates.

Different letters mean that there are significant differences at the probability level (0.05).

In a study conducted [19], and a study conducted [20], on the moisture content of camel meat, it was found in both studies that the camel thigh meat contained a moisture content of %75.10, which is less than the results obtained in the present study. As for the moisture content in duck meat, it was found that it is close to the results approached [21], but it is higher than the results of a study conducted by [22] who pinpointed that the moisture content in the meat of three breeds of duck (Peking, Muscovy, and Mallard) was (49.40, 56.60 and 55.80) %, respectively, while the moisture content in tuna meat was close to results found in a study implemented by [23]. However, it was less than that found in a study carried out by [24], when they studied two types of tuna, *Euthynnus affinis*, and *Auxis thazard*, where the study referred that the moisture content in the meat of these fish was %75.38 and %77.04 respectively.

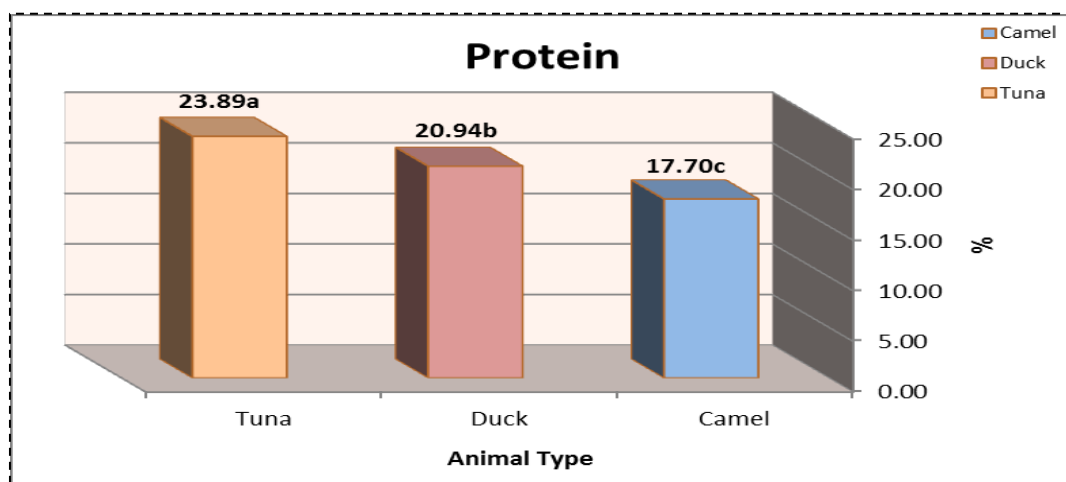
#### 3.1.2. Protein

In figure (3), results referred to the percentage of protein in camel, duck, and tuna meat. The study disclosed that there were significant differences at the probability level ( $P \leq 0.05$ ) in the percentage of moisture in camel, duck, and tuna meat. Tuna meat registered the highest percentage of protein %23.89, followed by the percentage of protein in duck meat, which amounted to %20.94, while camel meat registered the lowest percentage of protein, amounting to %17.70.

When comparing the results with previous studies, it was found that camel meat has a protein percentage similar to that found in a study conducted by [25] and less than the protein percentage referred to in a study carried out by [26] for camel thigh meat, which is %20.45, and the percentage of protein in duck meat was higher than the percentages that were reached in a study carried out by [27], who showed that the percentage of protein in the meat of three breeds of ducks (Peking, Muscovy, Mallard) amounted to (15.00, 18.50 and %17.30), respectively, but it was consistent with a study carried out by [28].

As to the percentage of protein in tuna meat, it was close to the percentage reached by [29] through its results, it is higher than what they found in a study conducted by [30] as they were studying two types of tuna, *Euthynnus affinis*, and *Auxis thazard*. Tahiri et. All brought to light that the percentage of protein in the meat of these fish amounted to %22.73 and %21.04, respectively.

The difference in the percentage of protein between the different types of meat in this study, and between previous studies was attributed to the different species, breeds, and muscular parts from which the meat is taken. The difference in the percentages of protein in the three types of meat is also due to the existence of an inverse relationship between moisture and protein, as the higher the moisture content is, the lower the protein percentage becomes.



**Figure 3.** Impact of Meat Type (Camel, Duck & Tuna) on the Protein Percentage.

All results mentioned in the table are an average of three replicates.

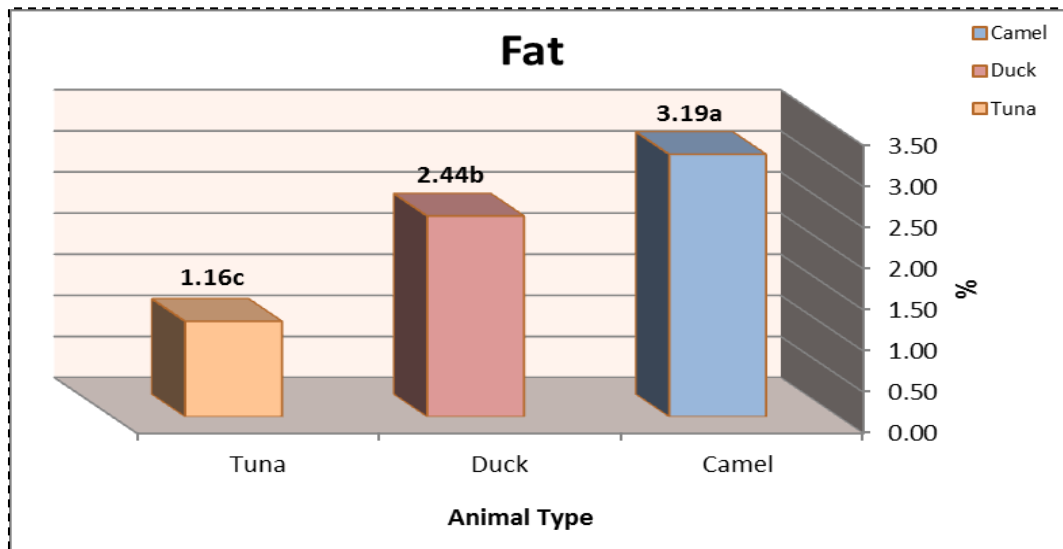
Different letters mean that there are significant differences at the probability level (0.05).

### 3.1.3. Fat

The results are shown in Figure (4) referred to the percentage of fat in camel, duck, and tuna meat. Statistical results made it clear that there was a significant impact at the probability level ( $P \leq 0.05$ ) for the impact of animal type on the percentage of fat in each of the three types of meat. The results of the study indicated that the percentage of fat in camel meat was %3.19, which is higher than the percentage of fat in duck meat (%2.44). However, the lowest percentage of fat in meat was in tuna (%1.16). The percentage of fat in camel meat was close to results found in a study conducted by [31] and [32] who mentioned that the percentage of fat in camel meat was 3.36 and %3.64, respectively.

Also, the percentage of fat in duck meat was higher than results found in a study conducted by [33], who stated that the percentage of fat in duck meat was %1.84, and higher than the values indicated in a study conducted by [34], who showed that the percentage of fat in the meat of two breeds of ducks (Muscovy and Mallard) amounted to (2.34 and 2.43) %, respectively.

The fat content of tuna meat was close to the results of a study conducted by Rani et al. in 2016, through its results, which stated that the percentage of fat in tuna meat was %1.08. However, it was higher than the results of a study carried out by [35], which showed that the percentage of fat in fish meat was (%0.93, %1.04) respectively in two types of fish, *Euthynnus affinis* and *Auxis thazard*.



**Figure 4.** Impact of Meat Type (Camel, Duck & Tuna) on the Fat Percentage .

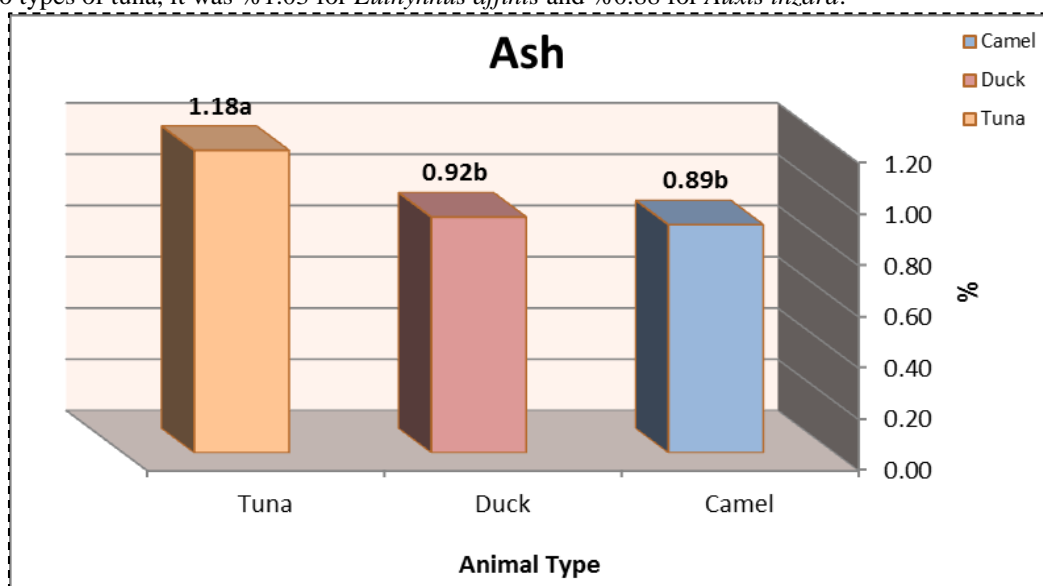
All results mentioned in the table are an average of three replicates.

Different letters mean that there are significant differences at the probability level (0.05).

#### 3.1.4. Ash

Figure (5) disclosed that there was a significant effect at the probability level ( $P \leq 0.05$ ) for the effect of an animal type on the percentage of ash in camel, duck, and tuna meat. Results showed that the percentage of ash in tuna meat was %1.18, which is considered the highest, followed by the percentage of ash in duck meat, which amounted to %0.92. The lowest percentage was recorded in camel meat, amounting to %0.89.

Results declared that the percentage of ash in camel meat was consistent with [36], but it was higher than the percentage of ash above mentioned in a study carried out by [37], reflecting that camel thigh meat, in general, contains a percentage of ash of %0.81. Besides, results showed that the percentage of ash in duck meat was close to that found in a study conducted by [8], but it is less than the percentage of ash (1.5 and 2.6%) for two breeds of ducks, the Muscovy and Mallard [39]. Besides, the percentage of ash in tuna meat was in a value more than that found in a study carried out by [38]. When studying the ash content of two types of tuna, it was %1.03 for *Euthynnus affinis* and %0.88 for *Auxis thazard*.



**Figure 5.** Impact of Meat Type (Camel, Duck & Tuna) on the Ash Percentage.



All results mentioned in the table are an average of three replicates.

Different letters mean that there are significant differences at the probability level (0.05).

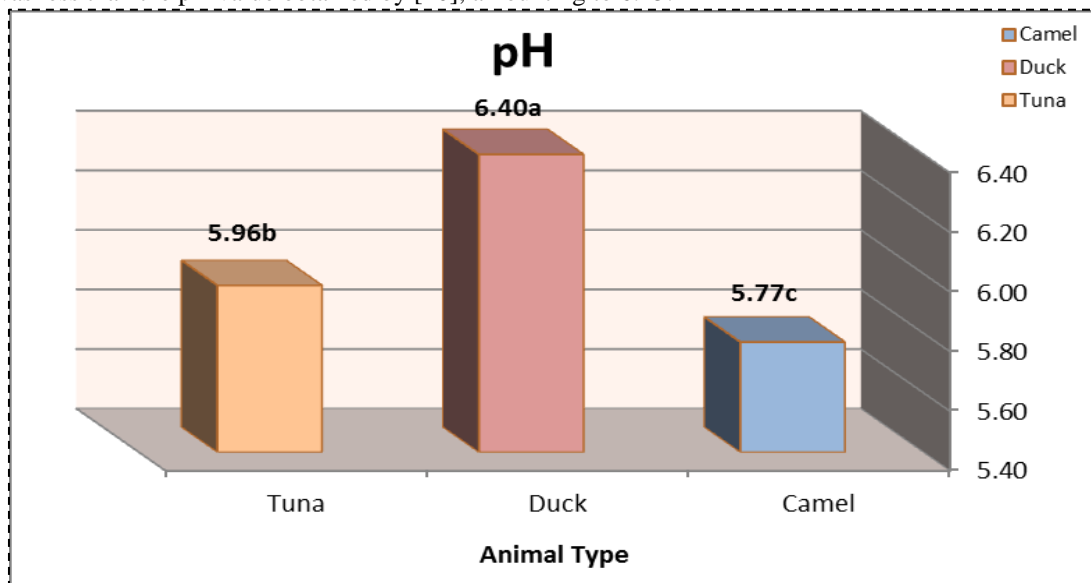
These differences occurred between the present study and other studies regarding the proportions of chemical composition in types of meat are attributed to differences due to the type of animal, breed, nutrition, environment, and others.

### 3.2. Physical Properties of Meat

#### 3.2.1. pH

As far as figure (6) is concerned, results revealed the impact of animal type on the pH of camel, duck, and tuna meat. Also, the statistical results made it clear that there were significant differences at the probability level ( $P \leq 0.05$ ) for the impact of animal type on the pH. Besides, the pH value of duck meat was higher than that of camel meat and tuna meat, as it reached 6.40, while the pH value of camel and tuna meat was 5.77 and 5.96, respectively.

In comparison with previous studies, it was found that the pH value of camel meat is close to the pH values obtained in a study conducted by [39]. As a result of samples analysis implemented on camel meat, researchers got the fact that the pH values were (5.91), and the pH value of duck meat was close to the results of a study conducted by [8], while the pH value of tuna meat was less than the pH value obtained by [40], amounting to 6.25.



**Figure 6.** Impact of Meat Type (Camel, Duck, and Tuna) on the Ph.

All results mentioned in the table are an average of three replicates.

Different letters mean that there are significant differences at the probability level (0.05).

Moreover, [18] stated that the fall in the value of the pH can be affected by the physiological state of the animal along with hunger and muscle stress before slaughtering. Or the pH value may rise higher than the normal limit, and this is due to the depletion of glycogen.

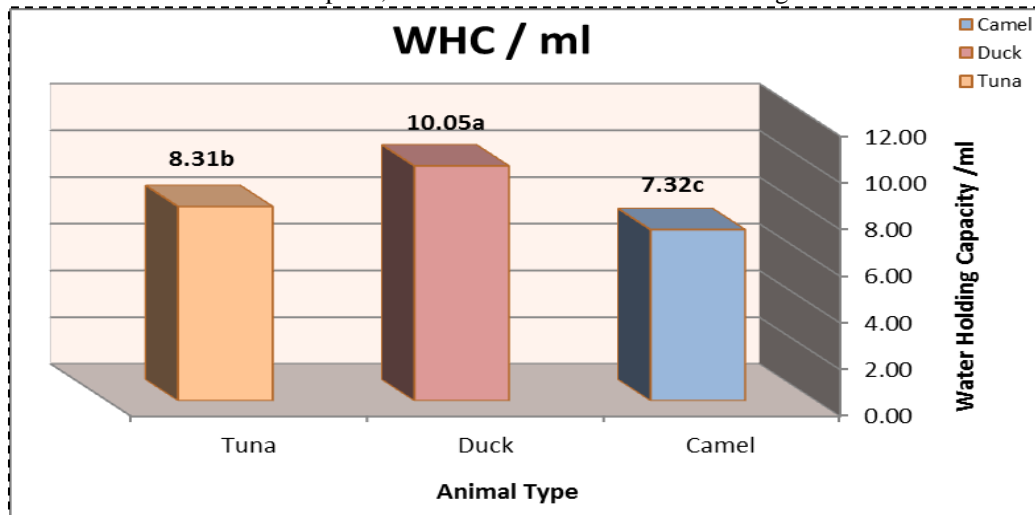
#### 3.2.2. Water Holding Capacity (WHC)

First, figure (7) referred to the impact of animal type on the water carrying capacity (ml) in camel, duck, and tuna meat. It was concluded, as a result of the statistical analysis, that the water carrying capacity was significantly affected at the probability level ( $P \leq 0.05$ ) in camel, duck, and tuna meat. Second, the highest value of water carrying capacity was in duck meat, which amounted to (10.05) ml, followed by the water carrying capacity of tuna meat, which amounted to (8.31) ml. Also, the study registered the lowest value of water carrying capacity in camel meat, amounting to (7.32) ml. The higher the pH value is, the higher the water carrying capacity becomes [13].

First of all, the value of the water carrying capacity of camel meat was much higher than that in a study conducted by [1] which is (1.36) ml. Also, the water carrying capacity of duck meat was less than that in a study carried out by [41]. They

disclosed that the water carrying capacity of the duck meat studied was (15.69) *ml*. Besides, the water-carrying capacity value was (6.08) *ml* in the studied tuna meat, according to a study accomplished by [42]. This was less than the value of water carrying capacity obtained in the studied tuna meat.

It is necessary to mention that the differences between the current study and other studies are due to the difference in the type of animal, breed, nutrition, a part taken from the carcass, and others. [38] brought to light that the fall in the water carrying capacity is attributed to the denaturation of myofibril proteins, especially *actin* and *myosin*, and to the rise in pH value that affected by muscle stress before being slaughtered. This phenomenon is due to the depletion of glycogen. Besides, the water-carrying capacity of meat decreases when the pH value gets (5.5), which is the Iso-electric point (IEP) of myosin. As the *pH* value of muscles is far from the Iso-electric point, the amount of water associated is high for the muscles of the animal [43].



**Figure 7.** Impact of Meat Type (Camel, Duck, and Tuna) on the Values of Water Holding Capacity

- All results mentioned in the table are an average of three replicates.
- Different letters mean that there are significant differences at the probability level (0.05).

### 3.2.3. Yield

First of all, results appeared in figure (8) concluded the impact of animal and protein type on the percentage of yield in myofibril and sarcoplasmic proteins of camel, duck, and tuna meat. The results of the statistical analysis indicated that the type of protein had a significant impact, at the probability level ( $P \leq 0.05$ ), on the percentage of yield in the three types of meat. Besides, it was evident that the overlapping impact between an animal type and a protein type was not significant in its impact on the percentage of yield in myofibril and sarcoplasmic proteins of camel, duck, and tuna meat.

Secondly, results made it clear that the percentage of the yield in myofibril and sarcoplasmic proteins of camel meat was (%13.93 and %2.80, respectively). As far as duck meat is concerned, it was noted that the percentage of the yield in fibrils and sarcoplasm proteins were (%20.99 and %6.50), respectively, while in tuna meat the percentage of the yield for myofibril and sarcoplasmic proteins was (%19.66 and %6.50), respectively. Thirdly, it was found that the percentage of myofibril proteins of duck meat was higher than that of tuna and camel meat, while the percentage of sarcoplasmic proteins of tuna meat was higher than that of duck and camel meat.

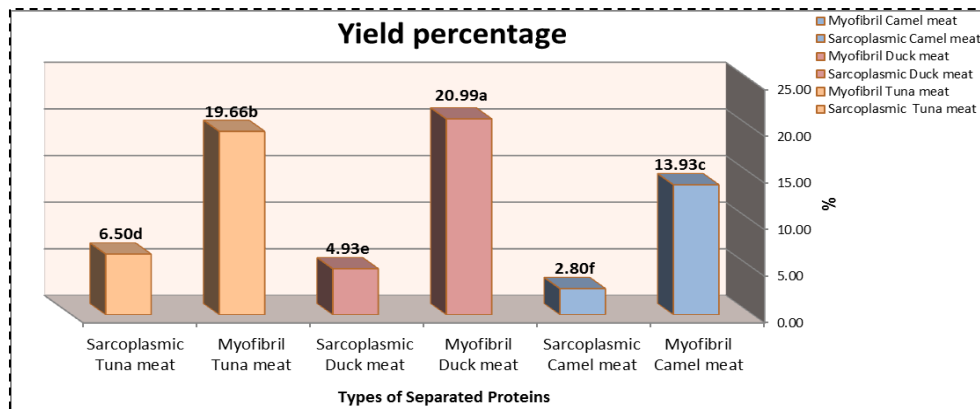
First of all, there were significant differences between the three sources of meat, where the yield of duck meat was the highest, while the proportions of the yield were close for each camel meat and tuna meat. This is attributed to the fact that the duck meat has a higher muscle content than camel and tuna meat, in which the proportion of bones and fat are more. It is necessary to reflect that these percentages are less than the percentage of the protein of isolated myofibril from that in the garfish, amounting to (%20.05) [44].

Besides, [17] shed light on the fact that the percentage of the yield of myofibril and sarcoplasmic proteins in camel meat was (%11.93 and %6.45), respectively, which is lower than the percentage of myofibril and sarcoplasmic proteins separated from the studied camel meat. A study implemented by [5] also disclosed that the percentage of the myofibril and sarcoplasmic proteins of camel meat was (%11.24, %5.50), respectively. These results are similar to results obtained in this current result, with a slight difference.

Also, [45] indicated that the percentage of myofibril proteins were (%13.63, %13.63) in beef and sheep respectively. This result was close to the percentage of myofibril proteins of the studied camel meat, while the percentage of sarcoplasmic proteins for beef and sheep was (%4.53, %4.32) respectively, which is higher than the percentage of sarcoplasmic proteins of

the studied camel meat. The researcher also found that the percentage of myofibril proteins and sarcoplasm proteins were (%16.0, %4.32), respectively, which is more than the percentage of myofibril and sarcoplasm proteins of the studied duck meat.

To conclude, the percentage of the yield varies according to the different proteins extracted. Also, this slight variation in the yield may be attributed to the difference in the percentage of protein in the meat used in the extraction. These results are consistent with the results of a study conducted by [28].



**Figure 8.** Impact of Meat Type (Camel, Duck, and Tuna) on the Yield Percentage in Myofibril and Sarcoplasmic Proteins.

All results mentioned in the table are an average of three replicates.

Different letters mean that there are significant differences at the probability level (0.05).

### 3.3. The Chemical Composition of the Proteins of myofibril and sarcoplasmic Extracted from Camel, Duck, and Tuna meat

#### 3.3.1. Moisture

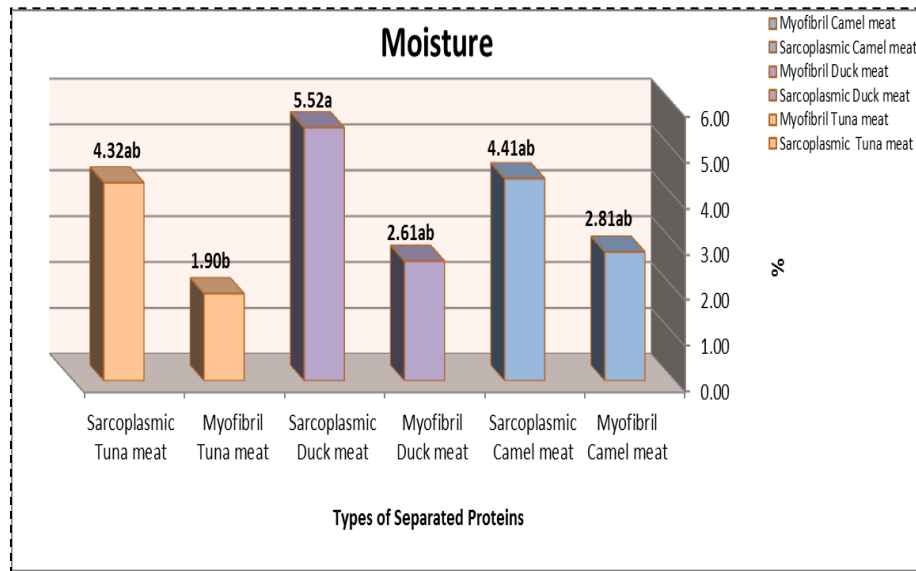
First of all, figure (9) stated the impact of animal type on the percentage of moisture of myofibril and sarcoplasmic proteins of camel, duck, and tuna meat. Statistical results showed a significant impact, at the probability level ( $P \leq 0.05$ ), on the type of animal in the percentage of moisture for camel, duck, and tuna meat. Besides, it was made clear that there was a significant impact, at the probability level ( $P \leq 0.05$ ), for the difference in the type of protein in the three types of meat, under study, in the percentage of moisture.

as shown in the figure, the moisture content of the myofibril and sarcoplasmic proteins in camel meat was (%2.81 and %4.41), respectively. As for myofibril and sarcoplasmic proteins of duck meat, they registered (%2.61 and %5.52), respectively. Besides, moisture was measured in the myofibril and sarcoplasmic proteins of tuna meat found to be (%1.90% and %4.32), respectively it was found that the highest percentage of moisture for myofibril proteins was in camel meat, while the lowest moisture percentage for myofibril proteins was in tuna meat, while the highest moisture percentage for sarcoplasm proteins was in duck meat, and the lowest moisture percentage for sarcoplasm proteins was in tuna meat.

[5] came up with a result stating that the moisture content of the myofibril and sarcoplasmic proteins of camel meat was (%11.24 and %5.50), respectively, which is more than the moisture percentage of the muscular proteins separated from the studied camel meat. Also, when studying the chemical composition of the proteins of myofibril and sarcoplasm extracted from beef and sheep, the moisture content of the proteins of myofibril and sarcoplasm of beef was (%4.12 and 5.16), respectively, while the moisture content of the proteins of myofibril and sarcoplasm of sheep meat was (%4.92 and %5.05) respectively.

in a study conducted by [8], it was concluded that there are significant differences in the moisture content between myofibril and sarcoplasmic proteins separated from the meat (breast and leg) of ducks, at the probability level ( $P \leq 0.05$ ). This result is close to the results obtained in the current study. Besides, the results were similar to the ones concluded in a study implemented by [10], disclosing that myofibril and sarcoplasmic proteins extracted from chicken meat had a moisture content of (%4.86 and %5.23), respectively.

Moreover, another study carried out by [35] brought to light that the moisture content of the fibrils proteins of tuna meat was 6.21%, which is much higher than the moisture content of the myofibril proteins of the studied tuna meat. Also, they found that the moisture content of sarcoplasm proteins was %3.31, which is lower than the moisture content of sarcoplasm proteins for the studied tuna meat.



**Figure 9.** Impact of Animal Type on the Moisture Percentage in Myofibril and Sarcoplasmic Proteins for Camel, Duck and Tuna’s meat.

All results mentioned in the table are an average of three replicates.

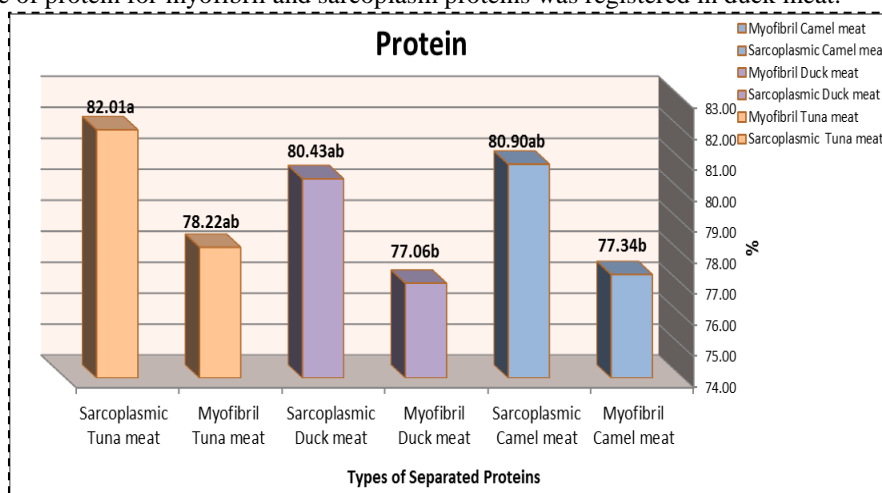
Different letters mean that there are significant differences at the probability level (0.05).

### 3.3.2 Protein

First, results shown in figure (10) indicated the impact of the type of protein on the percentage of protein in myofibril and sarcoplasmic proteins of the three types of meat studied. Statistical results shed light on the fact that there was a significant impact of the type of protein, at the probability level ( $P \leq 0.05$ ), on camel, duck, and tuna meat. Second, as it appeared through the statistical results, the percentage of protein was not significantly affected at the probability level ( $P \geq 0.05$ ) by the overlapping between the type of animal and the type of protein for each of the three types of meat.

Also, it was made clear that the percentage of protein for myofibril and sarcoplasmic proteins in camel meat was (%77.34 and %80.90), respectively. As for the myofibril and sarcoplasmic proteins of duck meat are concerned, the percentage of protein was (%77.06 and %80.43), respectively, while in the myofibril and sarcoplasmic proteins of tuna meat, the protein percentage was (%78.22 and %82.01), respectively.

Besides, it was revealed that the highest percentage of protein for myofibril and sarcoplasm proteins was in tuna meat, while the lowest percentage of protein for myofibril and sarcoplasm proteins was registered in duck meat.



**Figure 10.** Impact of Animal Type on the Protein Percentage in Myofibril and Sarcoplasmic Proteins for Camel, Duck and Tuna’s meat.

All results mentioned in the table are an average of three replicates.

Different letters mean that there are significant differences at the probability level (0.05).

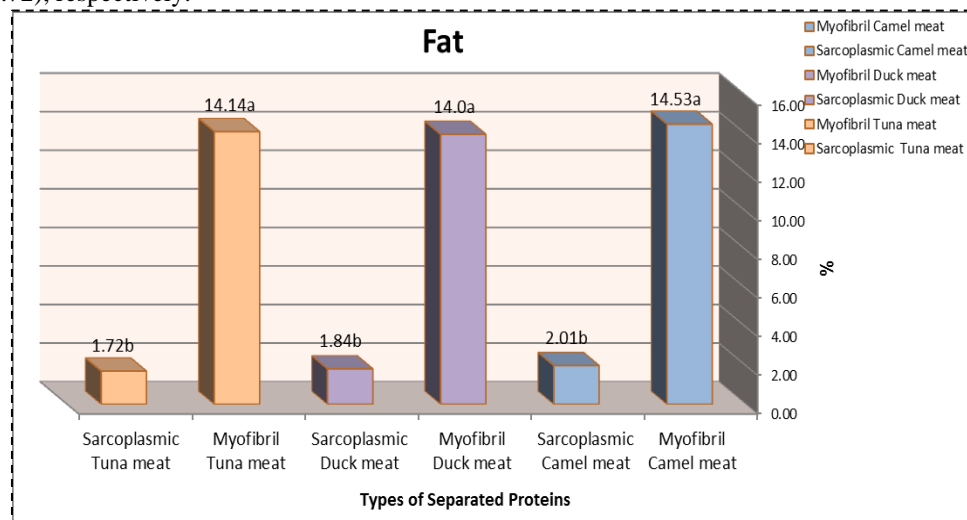
Moreover, when compared with other studies, it was found that the percentage of protein in camel meat myofibril was (%10.89) [5]. [30] also disclosed that the percentage of protein in the myofibril proteins of camel meat was (%2.87). These two values are less than the percentage that was obtained in the present study. The percentage of protein in the myofibril and sarcoplasmic proteins of sheep meat was (%85.72 and %86.90), respectively, and these percentages appeared consistent with the percentages that were obtained in this study.

Results obtained in a study conducted by [29] showed that the percentage of protein in duck meat is (%90.33), which is higher than the percentage of protein in myofibril proteins of the studied duck meat, while [10] brought to light that the percentage of protein in myofibril and sarcoplasm proteins extracted from chicken meat were (%85.80 and %85.90), respectively. These results are close to the ones made in the current study.

### 3.3.3. Fat

First, the results of figure (11) showed the impact of animal type on the percentage of fat in the myofibril and sarcoplasmic proteins of the three types of meat (camels, ducks, and tuna). Also, the results of the statistical analysis indicated that the type of protein had a significant impact, at the probability level ( $P \leq 0.05$ ), on the fat in the three types of meat. Besides, it was made clear that the impact of the overlapping between the type of animal and the type of protein was also significant in its impact on the percentage of fat in the myofibril and sarcoplasmic proteins of camel, duck, and tuna meat.

It was noted that the percentage of fat for myofibril and sarcoplasmic proteins in camel meat was (%14.53 and %2.01), respectively. As for the myofibril and sarcoplasmic proteins of duck meat, the percentage of fat was (%14.0 and %1.84), respectively. Regarding the myofibril and sarcoplasmic proteins of tuna, meat is concerned, the percentage of fat was (%14.14 and %1.72), respectively.



**Figure 11.** Impact of Animal Type on the Fat Percentage in Myofibril and Sarcoplasmic Proteins for Camel, Duck and Tuna's meat

All results mentioned in the table are an average of three replicates.

Different letters mean that there are significant differences at the probability level (0.05).

results made it clear that the percentage of fat in the myofibril and sarcoplasmic proteins of camel meat was higher than that in the myofibril and sarcoplasmic proteins of duck and tuna meat. Undoubtedly, this indicates that there was a significant impact of the different sources of meat on the percentage of fat.

[2] concluded that the percentage of fat in the myofibril proteins of camel meat was (%11.8), which is considered lower than the percentage in the myofibril proteins of the studied camel meat, while [27] found that the percentage of fat in the myofibril proteins was (%75.8), which is much higher than the percentage in the myofibril proteins of the camel meat that was studied. As for the percentage of fat in the sarcoplasmic proteins of the camel meat, it registered (%1.71), which is less than the percentage of the said fat in the sarcoplasm proteins of the studied camel meat.

results appeared in the current study stated that the percentage of fat was superior to that found in a study conducted by [10] on the percentage of fat in the proteins of myofibril and sarcoplasmic proteins extracted from beef and sheep, which were respectively % (0.86 and 0.82) and (0.82 and 0.79). The female researcher, in the same study, disclosed that the percentage of the fat content of myofibril and sarcoplasmic proteins, extracted from poultry meat, was (%0.82 and %0.70), respectively, which is much lower than the results obtained from the current study for muscular proteins extracted from duck meat.

### 3.3.4 . Ash

Results of the statistical analysis made available in figure (12) indicated that the impact of protein type was significant, at the probability level ( $P \leq 0.05$ ) in the percentage of ash for myofibril and sarcoplasmic proteins of camel, duck, and tuna meat. Second, results brought to light that the ash percentage of the myofibril and sarcoplasm proteins in camel meat was (%3.30 and %11.64), respectively. As to myofibril and sarcoplasmic proteins of duck meat, the ash percentage was (% 4.31 and %11.0), respectively. As far as the myofibril and sarcoplasmic proteins of tuna meat are concerned, the percentage of Ash was (%3.72 and %10.92), respectively.

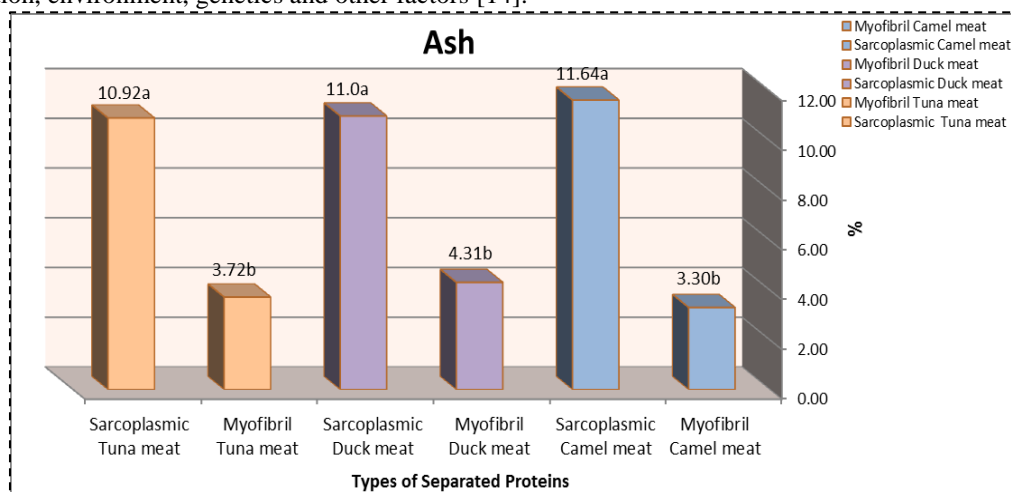
Besides, the study showed that the percentage of ash in myofibril proteins of duck meat was higher than it is in myofibril proteins of camel meat and tuna, while the percentage of ash in sarcoplasmic proteins of camel meat was higher than it is in sarcoplasm proteins of duck meat and tuna meat. This was an indication of the significant impact of a source of meat on the percentage of ash.

Also, [2] found that the percentage of ash in the myofibril proteins of camel meat was (%2.6), which is lower than the said percentage found in this study. Results made in another study, it appeared that the percentage of ash in the myofibril and sarcoplasmic proteins of camel meat was (%2.84 and %4.23), respectively, which is lower compared to the present study's results [30].

Moreover, [10] disclosed that the percentage of ash in the myofibril proteins of beef and sheep was (%6.23 and %6.71), respectively. These percentages were superior to the percentages reached for the myofibril proteins of the studied camel meat. As for the Ash percentage of the sarcoplasmic proteins of beef and sheep was (%6.67 and %6.90), respectively. These percentages are lower than the percentages recorded for the myofibril proteins of the currently studied camel meat.

First of all, [32] pinpointed that the percentage of ash in the myofibril and sarcoplasmic proteins of duck meat was (%3.64) and (%7.41), respectively, which is lower than its percentage in the myofibril and sarcoplasmic proteins that are currently compared to. It was also found that the percentage of Ash recorded previously by [10], for the myofibril proteins of chicken meat were (%6.35), which is higher than the Ash percentage of the studied duck meat. While the Ash percentage of the sarcoplasmic proteins of chicken meat recorded (%6.66) was lower than that in the sarcoplasmic proteins of the studied duck meat. Also, the percentage of ash in the myofibril proteins of tuna meat was (%6.31) [33], which is higher than that of the myofibril proteins of the studied tuna meat.

Also, the components of the chemical composition (moisture, protein, fat, and ash) of the myofibril and sarcoplasmic proteins of camel, duck, and tuna meat varied according to the different types of proteins under study and for reasons that may be due to the varying content of these proteins from water, solids, fatty substances, and mineral salts that differ according to gender, sex, age, nutrition, environment, genetics and other factors [14].



**Figure 12.** Impact of Animal Type on the Ash Percentage in Myofibril and Sarcoplasmic Proteins for Camel, Duck and Tuna's meat.

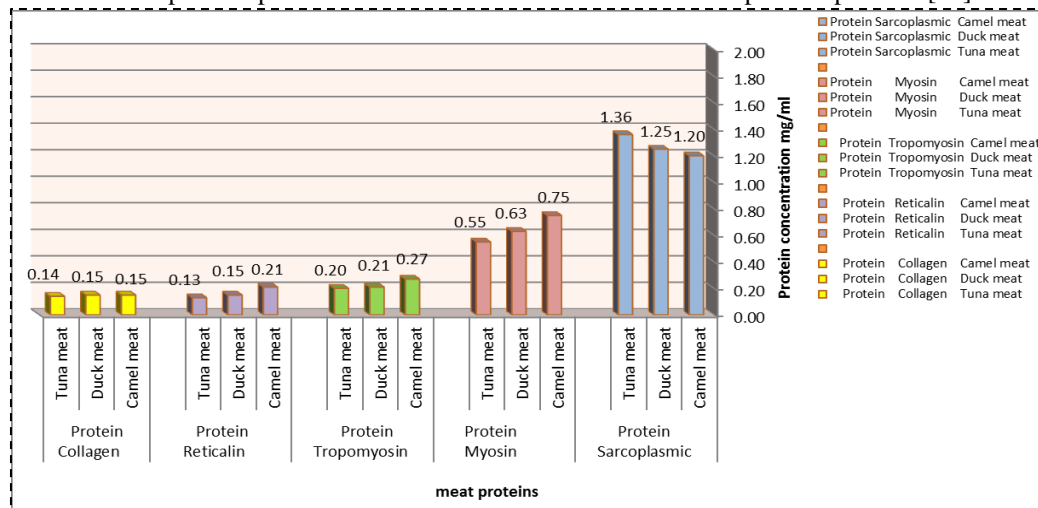


All results mentioned in the table are an average of three replicates.

Different letters mean that there are significant differences at the probability level (0.05).

### 3.4. Separation of Muscular Proteins (Myofibril, Sarcoplasmic and Connective Tissues) of Meat (Camels, Ducks, and Tuna) by Chemical Method

[17] referred to the fact that camel meat contained (%9.22) collagen. It is a concentration exceeding the value obtained from this protein in camel meat. The concentration of myofibril and sarcoplasm proteins of tuna meat was (6.21 and 3.31) mg/ml, which is lower than the sarcoplasmic proteins content of studied tuna meat of sarcoplasmic proteins [35].



**Figure 13.** Percentage of Muscular Proteins (Myofibril, Sarcoplasmic and Connective Tissues) of Camels, Ducks and Tuna's Meat

All results mentioned in the table are an average of three replicates.

Different letters mean that there are significant differences at the probability level (0.05).

## Conclusions

It is obvious that:

1. The statistical results indicated that there were significant differences at the probability level ( $P \leq 0.05$ ) in the percentage of moisture, protein, fat, ash, pH, and water carrying capacity values in camel meat, duck meat, and tuna meat.
2. It was observed that the percentage of moisture and fat in camel meat was higher than that of duck meat, while the lowest percentage of moisture was in tuna meat, while tuna meat recorded the highest percentage of protein and ash, followed by the percentage of protein and ash in duck meat, while camel meat recorded the lowest percentage. For protein and ash, the results also showed that the values of pH and water carrying capacity of duck meat were higher than tuna meat and camel meat.
3. The results of the statistical analysis showed a significant effect of meat type, protein type, and bilateral interaction at the probability level ( $P \leq 0.05$ ) on the chemical content and physicochemical properties of meat, as well as for myofibrillar proteins and sarcoplasmic proteins separated from them.

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