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# Myofibrillars and Sarcoplasmic Proteins Separated The Effect of Different Preservation and Cooking Methods on Functional Characteristics of From Common Carp and Silver Carp Prof.

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## Abstract

The current study dealt with the use of methods of preserving (freezing and salting with drying), cooking methods (grilling and cooking in broth and frying) and studying their effect on functional characteristics (solubility, amount of water and oil absorbed, viscosity, emulsification, foaming, gel formation) of myofibrillars and sarcoplasmic proteins separated from carp meat, common and silver carp diagnosed with electrophoresis technique, the study was conducted during the period (10 / 2018-1 / 2020). The results were as follows:

1. Dried fibrous proteins and dried sarcoplasm proteins separated from fish meat have given a good functional properties compared to commercial cow's albumin.
2. It was found that the percentage of solubility and gelatinization of commercial cow's albumin protein was higher than in the myofibrillars and sarcoplasmic proteins separated from the two types of fish, whereas the amount of water absorbed by the commercial cow's albumin protein was less than of myofibrillars and sarcoplasmic proteins, while the amount of absorbed oil, viscosity, and emulsion composition. The commercial cow's albumin was comparable to the myofibrillars and sarcoplasmic proteins, and when comparing the foam properties of the myofibrillars and sarcoplasmic proteins of common carp and silver carp with the commercial cow's albumin at a concentration of 1% and at the normal pH = 7, it was found that the foam size and persistence of sarcooplasmic proteins were close to the size and persistence of the foam for the commercial protein at the normal pH, while the volume and stability of the foam for myofibrillars proteins were slightly lower than in cow's albumin.
3. It was observed that the solubility values in the myofibrillars proteins and the sarcoplasmic proteins of the samples were close to each other when using preservation methods while the solubility of the myofibrillars proteins was lower than the solubility of the sarcoplasm proteins of the cooked samples. It was found that the amount of oil absorbed by the myofibrillars proteins was higher than the sarcoplasmic proteins, but that its viscosity and its ability to bind water and its ability to form gel were lower than it, and the capacity of emulsifiers of protein myofibrillars and their stability was higher than the capacity and the stability of emulsions of sarcoplasm proteins, as for the type of fish and the type of protein stability of emulsions, it was noted that there was a slight difference in the capacity of emulsions and the stability of emulsions for myofibrillars proteins as well as for sarcoplasm proteins. The emulsification values did not seem different between the two types of fish.
4. It was found that freezing contributed to reducing solubility and the amount of water absorbed while it had a role in increasing the amount of oil absorbed to fish proteins more than salting and drying. The freezing, as well as salting and drying were reduced the viscosity of proteins a little bit, also freezing reduced stability of emulsionsfor two type of fish proteins,but salting and drying was rised it, and the degree of influence of the measured foam property in myofibrillars and sarcoplasmic proteins of the fish species by means of preservation and cooking different methods was very small because the values were closely related, and we did not find a specific pattern that we could apply in terms of challenging degree of difference, freezing and salting with drying, grilling and frying and cooking in the broth sometimes susceptibility raises values formation of foam and other reduce it.
5. The solubility of proteins that measured on fish which cooked in broth was more than the solubility of grilled and fried samples. It was observed that the solubility values in myofibrillars proteins and sarcoplasm proteins for the cooked samples were close to each other, and the amount of water and absorbed oil, foam properties and viscosity of the measured proteins in cooked fish were not affected by the cooked methods whose used because the closely related of values .

6. Generally the results showed that the solubility and viscosity values in the samples of common carp were lower than in the silver carp which preserved and cooked by different ways, but the ability of common carp to bind the oil was higher than that of silver carp when using conservation methods while the values were close at the use of cooking methods, and we noted that there were no noticeable differences between myofibrillars proteins and sarcoplasmic proteins for the two fish species in their ability to bind water and their ability to form gel. It was also noted that there was a slight difference in the capacity of emulsions and their stability to myofibrillars proteins as well as to proteins sarcoplasm between the two types of fish.
7. The fish type, preservation methods, cooking methods, and di-interference had a significant effect at the probability level ($P \leq 0.05$) on the percentage of solubility and the amount of water and oil absorbed by the myofibrillars and sarcoplasmic proteins separated from the meat of these fish, but did not significantly impact the viscosity of the protein**.**

Keywords: Preservation methods, Cooking methods, Functional characteristics, Fibrous proteins.

## 1.Introduction

Food proteins, in addition to providing them with the nutritional value, must possess specific functional properties. The functional properties of proteins in food refer to the physiochemical properties that govern the behavior of protein in foods, for example, solubility, binding properties, surface tension, viscosity, etc.[1].

Protein functional properties improve sensory qualities such as color, flavor, texture, smoothness or roughness in the texture, puffiness, gelatinization, foam formation , emulsification, solubility, rubbery, viscosity, and ability to bind water and oil [2], manufacturing processes food products depends on the ability of protein to bind to water and fat and to maintain this binding for as long as possible. This bind takes on phenotypic forms that were reflected in the protein, such as rubbery, the ability of molecules to swelling, emulsion formation, juicing, and hold moisture, for example, the foam capacity of egg whites was important when making cakes, and the properties of rubbery and viscosity of gluten protein were important in making bread, and curding milk was important in making cheese, viscosity and solubility were important for some drinks, emulsions and water binding and gel formation were important characteristics in the manufacture of sausage and other meat products [3].

The importance of the functional properties of protein materials was determined mainly by the presence of hydrophilic groups and hydrophobic groups, as these two groups were of great importance. The presence of hydrophilic groups greatly improves the properties of dissolving, foaming, and gelatinization. while the presence of hydrophobic groups, it was important to binding fat, since It tends to enter the air as in foam or oil as in emulsification, and the presence of Non-covalent bonds works to form a coherent film that improves the properties of foam and emulsification [4].

[5], explained that the functional properties of a protein, such as viscosity and gelatinization, as well as sensory properties such as color and odor, were affected by the temperatures used during the extraction process, and that the best functional properties were the result of using low temperatures and long extraction periods in order to break transverse bonds and peptide bonds when using high degrees of heating along the extraction time to breaks the hydrogen bonds that form the basis for the stability of protein structure.

The aim of the research**:**The present study aims at separating myofibrillars and sarcoplasmic proteins from the meat of common carp and silver carp ;moreover, it aims to study the functional characteristics (solubility, amount of water, oil absorbed, viscosity, emulsification, foaming and gel formation) of myofibrillars and sarcoplasm proteins in the meat of these fish.

## 2.Materials and Methods

### *2.1.Materials*

#### *2.1.1.Fish Samples*

Samples of fresh fish (common carp 'Samty' and silver carp 'Dukhan') were brought from the local markets of Basrah city and kept in refrigerated folders. After arriving at the laboratory, a section of them was kept frozen for a period of four months, as well as conducting salting by 10% and other samples were drying for a period of four months. Further, the use of cooking methods such as grilling for fish samples at 300 º and for 45 minutes and cooked broth at 100 º for 45 minutes as well as frying with oil at 200 º for 45 minutes were conducted accordingly.

## *2.2. Methods*

### *2.2.1. Extraction of Muscular Proteins (myofibrillars and Sarcoplasmic)*

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**.**

- The meat was cut and finely chopped**.**
- 200g of minced meat was taken**.**
- The minced meat is mixed with a NaCl 1% saline solution in a 2: 1 ratio (meat: a saline solution) with an electric mixer**.**
- 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**.**
- The sediment was emptied by the Vacuumed Oven at 55 ° C**.**
- After drying, the precipitate was ground with a ceramic mortar to soften it, and then it was kept in the refrigerator at 7 ± 2 C$^{o}$ until use**.**
- The filtrate was rotated with the Rotry Vaccum Evaporator at 50 ° C and was freezdryed and stored in the refrigerator at 7 ± 2 ° C until use**.**

### *2.2.2. Functional properties of proteins*

The functional properties of the separated myofibrillars proteins and sarcoplasmic proteins have been studied and compared with the functional properties of the commercial protein (cow's albumin). These properties include solubility, water absorption, lipid bonding, viscosity, emulsification, gelatinization and foaming**.**

- Solubility

Protein solubility was determined by using the method of [8], as the protein content was determined in proteins (P1) and in the leachate from the protein solution at a concentration of 1% (P2). The solubility percentage was calculated by the following formula**:**

$$\text{Solubility } \% = P1 / P2 \times 100$$

- Water absorption

The ability of the protein to bind water was estimated using the method of [9], by mixing 1 g of sample with 10 ml distilled water for 30 seconds, the samples were left for 30 minutes, then they were separated by centrifugation and the amount of water absorbed was calculated, according to the following formula**:**

Amount of absorbed water (ml / gm) = amount of water added (10 mL) - the amount of water after separation

- Fat binding

The ability of the protein to bind oil estimated by using the method of [10], by mixing 1 g of the sample with 10 ml of corn oil for 30 seconds, the samples were left for 30 minutes and then centrifuged by 3000 cycles / min for 20 minutes and the amount of the absorbed fat calculated, According to the following formula**:**

Amount of absorbed fat (ml / gm) = added amount of fat (10 mL) - the amount of fat after separation

- Emulsification property

The ability of the protein to emulsification was estimated according to the method used by [11], by mixing 1 g sample with 50 ml distilled water and 10 ml of corn oil for two minutes using the electric mixer, then the mixture was transferred to a graduated cylinder to calculate the time of emulsion per second and the size of the emulsion layer and the volume of water layer (ml).

- Viscosity property

The viscosity property was measured according to [12], and tables in [13]were used to extract the specific density and viscosity of water at the laboratory temperature of 23 ° C, as the sample solution was prepared with a concentration of 1% and a measurement of its viscosity at the laboratory temperature using Ostwald Viscometer Size B.

- Foaming property

Protein ability to form foam was established by [14]method, whisk 1 g of sample with 100 ml of distilled water for 3 minutes, and foam volume was measured after (0, 10, 20, 30, 60) minutes and at pH (4, 7, 9).

- Gelatinization property

The gelatinization property was estimated according to the method of [15], as concentrations (1, 3, 5, 10, 15) were prepared in 5 ml of distilled water, and the tubes were heated in a water bath (70 - 75) º C for an hour and then cooled by placing it in Snow bath for one hour, after which it was overturned and noticed the gel was broken or not.

### *2.3.Design and Statistical Analysis*

The data were analyzed statistically using the Complete Randomized Design (C.R.D) within the Special Program for Statistical [16] and then the factors studied were tested using the L.S.D Least Significant Difference Test at the probability level (0.05).

## 3.Results and Discussion

### *3.1.Functional properties of fish proteins*

#### *3.1.1.Solubility*

The results in Table (1) indicate the percentage of solubility of the myofibrillars and sarcoplasmic proteins extracted from the common carp and silver carp samples preserved with different preservation methods as well as cooked with different cooking methods.

It appeared that the percentage of solubility in myofibrillars and sarcoplasmic proteins for common and silver carp (75, 76) % and (76, 78) % respectively, while the percentage of myofibrillars and sarcoplasmic proteins for frozen fish reached (38, 41) % and (38, 41) % respectively, concerning myofibrillars proteins and sarcoplasmic proteins of dried salted fish were about (39, 38) % and (47, 45) % respectively, while in myofibrillars and sarcoplasmic proteins of grilled fish, the solubility was about (36, 37) % and (44, 44) % respectively, while the percentage was in myofibrillars and sarcoplasmic proteins for fish cooked in broth about (41, 40) % and (47, 45) % respectively, it was noted that the solubility of myofibrillars and sarcoplasmic proteins of fried fish was (36, 35) % and (45, 45) % respectively, the freezing has contributed to reducing the solubility of fish proteins more than salting and drying. This may be attributed to an increase in the percentage of hydrophobic groups due to the high pH value due to the effect of freezing. It was noted that the solubility values in myofibrillars and sarcoplasmic proteins for samples were closely related to each other when using conservation methods while they were the solubility of myofibrillars proteins was less than that of sarcoplasmic protein for cooked samples.

The solubility of the proteins measured in fish cooked in broth more than solubility of the grilled and fried samples. It was observed that the solubility values in myofibrillars and sarcoplasmic proteins were close to each other, in general the solubility of sarcoplasmic proteins was higher than the myofibrillars proteins, the reason for the variation in the percentage of the protein in common carp and silver carp fish differ in the content of these proteins from hydrophilic and hydrophobic amino acids. The higher percentage of hydrophilic amino acids leads to increased solubility. For hydrophobic amino acids leads to reduced solubility, as these amino acids tend to aggregate together and were difficult for water to penetrate [17].

From the statistical results, there were significant differences at the probability level ($P \leq 0.05$) of the effect of the fish type, the effect of conservation methods, different cooking methods and the interference between them and the type of fish in the solubility of myofibrillars and sarcoplasmic proteins. The results generally showed that the solubility values in common carp fish samples were lower than in preserved and cooked silver carp samples in different ways.

In comparing the percentage of solubility of myofibrillars and sarcoplasmic proteins with the percentage of solubility of commercial cow's albumin protein, we find that the solubility rate of commercial protein was 88.38 %, it was higher than that of the myofibrillars and sarcoplasmic proteins separated from the two fish types.

The results showed that the percentage of solubility was closed to that reached by the [18]when studying the percentage of solubility of myofibrillars proteins for carp and sapoor fish (85.60 and 83.80) % respectively, while the percentage of solubility of sarcoplasmic proteins was (82.50 and 81.60) % for this fish respectively, but the results of the current study were higher than what [19]found when he studied the solubility ratio of myofibrillars proteins separated from cod muscles, as it was 60.00 %.

[20]indicated that solubility was an indicator of the extent of dentration in muscle fiber proteins. Extraction was associated with the extent of protein solubility and the properties of muscle structure. The solubility of proteins was associated with the synthesis of amino acids on the surface of the protein and the extent of their interaction with the solvent. The most important interactive functional groups in proteins and any breakdown of cystine or cysteine during fish storage was evidenced by the disappearance of SH groups, which enhance the effectiveness of proteins and the number of effective SH groups increases on the surface of the protein with the opening of the protein when exposed to severe conditions.

[21]measured the solubility of myofibrillars and sarcoplasmic proteins of the fresh sea snake *Mastacembelus armatus* with values of (44.93 and 59.16) mg / gm respectively, and mentioned [22]The solubility of myofibrillars and sarcoplasmic proteins for fresh tilapia was (66, 34) % respectively, as shown by [23]. The solubility myofibrillars and sarcoplasmic

proteins for rhoe was (76.5, 47.6) mg / gm respectively, As for [24], the solubility of myofibrillars and sarcoplasmic proteins of common carp and fresh silver carp was (46.65, 53.29) mg / g and (80.91,116.85) respectively, and [25]found that solubility running fish proteins were (2.51 ± 0.31) %.
[26]explained that the solubility values of frozen mackerel and whit- blue cod at -20 º C for an eight-month period (0, 30, 60, 150, 240) days were (78.9, 54.3, 41.9, 38.3, 30.2) % In mackerel fish and (73.5, 42.9, 40.3, 43.5, 25.5) % in cod fish, the protein solubility was higher in mackerel fish, and it was more stable than cod fish that suffered from dentration and accumulation in its proteins, and differences in protein stability between few fats fish and semi-fatty, such as cod and mackerel respectively, to the protective effect of neutralized fats against free fatty acids (FFA) other than dissolved and prevent its impact on proteins, while in free fish fat (cod) There are no fat neutral able to resist the work of FFA, although fish semi-fatty acids (mackerel, horse) containing these fat sufficient concentration and distributed appropriately so that they can maintain proteins.
[27], explain that the protein solubility behavior for raw and cooked sturgeon slices (grilling and frying) with the effect of pH (1, 2,3, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12), as all The three samples exhibit typical behavior. The U-shaped solubility curve appears with the minimum solubility in the electrical neutral point, which was around pH 5, then the solubility was increased on both sides of this point, as fresh samples showed high solubility in acid and alkaline pH values this data was similar to the results obtained by [28]when studying the solubility of white muscle of herring *Clupea harengus*, where the solubility of the protein decreased significantly in both grilled and fried samples at all pH values, in grilled samples, the solubility of protein was 19 % at pH = 2, compared to 89 % in fresh samples, and at the pH = 11 The solubility of the grilled sample was 35 %, while in the fresh sample it was 87 %, and the behavior of the solubility of proteins in fried samples was similar to the grilled method. This was in line with previous studies that indicated low protein solubility because of the heat treatment, as the data indicates that the thermal treatments cause the denaturation of the proteins of sturgeon slices and reduce their solubility in water at different pH values [29,30], and by comparing the present study with these studies we found that there were clear differences in the results.

### *3.1.2. Water absorption*

The results are shown in Table (1) the amount of water absorbed (ml water / gm of the sample) for myofibrillars and sarcoplasmic proteins extracted from the samples of common carp and silver carp preserved with different preservation methods as well as cooked with different cooking methods. It was found that the amount of water absorbed in the myofibrillars proteins and sarcoplasmic proteins of fresh common and silver carp fish (1.1, 1.0) ml water / gm from the sample and (1.3 and 1.1) ml water / gm of the sample respectively, while the ratio of amount of water absorbed for myofibrillars proteins and sarcoplasmic proteins to two types of frozen fish reached to (0.9, 0.9) ml water / gm from the sample and (0.9, 1.0) ml water / gm from the sample respectively, and in the myofibrillars and sarcoplasmic proteins of the dried salted fish were about (1.1, 1.1) ml water / gm from the sample and (1.2 and 1.2) ml water / gm of the sample respectively, in the myofibrillars proteins and sarcoplasmic proteins of the grilled fish the amount of water absorbed was about (1.0, 0.8) ml water / gm from the sample and (1.2, 1.1) ml water / gm from the sample respectively, while the amount in the myofibrillars proteins and sarcoplasmic proteins of the fish cooked in broth was about (0.8, 0.9) ml of water / gm of the sample and (1.2 and 1.2) ml of water / gm of the sample respectively. It was observed that the amount of water absorbed by the myofibrillars proteins and sarcoplasmic proteins of the fried fish was (1.1, 0.9) ml of water / gm of the sample and (1.1, 1.1) Ml of water / gm of the sample respectively, and it was found that the freezing contributed to reducing the amount of water absorbed to fish proteins while salting and drying resulted in raising their values compared with fresh samples, the reason for this may be attributed to the low solubility of proteins, which particularly affects the water absorption capacity of fish meat to increase the number of groups that detest water, and the amount of water absorbed by the proteins measured in cooked fish was not affected by the cooking methods that were used because the values were closely related. We noted that there were no noticeable differences between myofibrillars proteins and sarcoplasmic proteins for the two fish species in their ability to bind to water.
All these results it was clear that the water absorption capacity of myofibrillars proteins was lower than the water absorption capacity of sarcoplasmic proteins, the reason for this variation was due to the change in the nature of the protein as well as the variation in the size of the material particles that play a major role in determining the amount of water absorbed, and the water absorption capacity was affected by a different type Protein, and the presence of polar groups as well as the solubility of these proteins. Soluble proteins reduce the amount of water absorbed, and uncompletely soluble proteins increase water absorption [31], and increased water absorption. It was due to the increase in the percentage of high molecular weight proteins that have an effect in increasing the water absorption capacity by increasing the polar sites on the surface of the molecules. These sites can bind the water with a physical force that was difficult to separate, so the other water molecules were destroyed and form a shell or a space of water around each of the atoms of the substance to be sufficiently moisturizing [32].

From the statistical results, it was found that there were significant differences at the probability level ($P \leq 0.05$) for the effect of fish type, the effect of conservation methods, different cooking methods and the interaction between them and the type of fish in the amount of water absorbed by the myofibrillars proteins and sarcoplasmic proteins.
In comparing the water absorption capacity of myofibrillars proteins and sarcoplasmic proteins with the water absorption capacity of commercial cow's albumin protein, it was observed that the water absorption of studied proteins was higher than the water absorption of cow's protein which was 0.15 ml water / g. [33], found that the ability to bind water to the proteins of catfish was (3.38 ± 0.03) ml water / g, and the results show that the amount of water absorbed was closed to the findings of the [34], which showed that the amount of water absorbed by the myofibrillars proteins of carp and sapoor fish was 0.9. ml of water / gm sample. As the amount of water absorbed by the sarcoplasmic proteins for both types of fish, it was 1.0 ml water / gm sample at the normal pH and showed that the highest water absorption of the two types of proteins was at pH 4, and the lowest water absorption of these proteins was at pH 9, And the reason for these differences in the susceptibility of Water absorption routines were due to their solubility, as the more dissolved the protein, the less its ability to absorb water [35].

### *3.1.3. Fat binding*

Through the results in Table (1), it was indicated the property of fat binding or the amount of oil absorbed (ml oil / gm of the sample) for myofibrillars proteins and sarcoplasmic proteins extracted from samples of common carp and silver carp preserved silver carp and cooked in different ways.
The amount of oil absorbed in the myofibrillars proteins and sarcoplasmic proteins of fresh common and silver carp fish was (2.8, 2.7) ml oil / gm from the sample and (2.6, 2.5) ml oil / gm of the sample respectively, while the amount of myofibrillars and sarcoplasmic proteins of the fish amounted on the frozen (3.0, 3.2) ml oil / gm of the sample and (2.8, 3.0) ml oil / gm of the sample respectively, and in the myofibrillars proteins and sarcoplasm proteins of the dried salted fish were about (2.3, 2.7) ml oil / gm of the sample and ( 2.2, 2.4) ml oil / gm of the sample respectively, in either myofibrillars proteins or sarcoplasmic proteins of grilled fish the amount of oil absorbed was about (2.5, 2.3) ml oil / gm from the sample and (2.2, 2.2) ml oil / gm from the sample respectively, while the amount in the myofibrillars and sarcoplasmic proteins of the samples cooked in broth was about (2.6, 2.6) ml oil / gm from the sample and (2.5, 2.5) ml oil / gm from the sample respectively. It was noted that the amount of oil absorbed by the myofibrillars and sarcoplasmic proteins for fried fish was (2.4, 2.2) ml oil / gm from the sample and (2.5, 2.3) Ml of oil / gm of the sample respectively, and the freezing contributed to increasing the ability of proteins to absorb oil more than salting and drying compared to fresh samples. The reason for this was due to the increase in the percentage of hydrophobic groups that increase the susceptibility of proteins to the binding of fat, and the amount of oil absorbed by the measured proteins in the cooked fish that was used was not affected by the fact that the values were closely related, as was the amount of fat absorbed by the commercial cow's albumin protein 1.6 ml oil / g of sample was close to the amount of oil absorbed by the myofibrillars and sarcoplasmic proteins.
From the statistical results, significant differences were observed at the probability level ($P \leq 0.05$) of the effect of the fish type, the effect of conservation methods, different cooking methods and the interference between them and the type of fish in the amount of oil absorbed by myofibrillars and sarcoplasmic proteins, and that the ability of common carp to bind to the oil was higher than silver carp when using preservation methods while values were close when using cooking methods.
The results have shown that the myofibrillars proteins with the ability to bind to fat exceed the sarcoplasmic proteins, as the susceptibility to binding the fats was affected by the difference in the type of protein [36], as the reason may be due to high solubility through non-polar sites located on the surface of their molecules, or that fibers contain a small amount of fat, as the lower the initial protein content of the fat, the greater its susceptibility to binding the fat [37], and this what showed [38] when studying binding the fat on dried products of anchovy fish.
The results of the current study were higher than that found by [39]according to the amount of fat absorbed by myofibrillars proteins and sarcoplasmic for carp and sapoor fish, as the amount of fat absorbed for myofibrillars proteins reached (1.2 and 1.3) ml oil / g sample in a row, and for sarcoplasmic proteins reached (1, 1.10) ml oil / gm sample respectively, for both fish types, and found [14]The lipid binding capacity of catfish fish proteins was (4.08 ± 0.14) ml oil / g.

### *3.1.4. Viscosity*

The results in Table (1) indicated the viscosity of myofibrillars and sarcoplasmic proteins extracted from the samples of common carp and silver carp preserved and cooked in different methods as measured by centipoise.
It was found that the viscosity of myofibrillars and sarcoplasmic proteins for common and silver carp were (0.9341, 0.9224) centipoise and (0.9866, 0.9898) centipoise respectively, while the value of myofibrillars and sarcoplasmic proteins for frozen fish was (0.9233, 0.9213) centipoise and (0.9765, 0.9882) centipoise respectively, and in myofibrillars and sarcoplasmic proteins of dried salted fish were about (0.9076, 0.9453) centipoise and (0.9794, 0.9876) centipoise respectively, while in myofibrillars and sarcoplasmic proteins for grilled fish, the viscosity was about (0.9100, 0.9254) centipoise and (0.9854, 0.9882) centipoise respectively, while the value in myofibrillars and sarcoplasmic proteins of fish cooked in broth was

approximately (0.9409, 0.9234) centipoise and (0.9874, 0.9852) centipoise respectively, and it was observed that the viscosity of myofibrillars and sarcoplasmic proteins for fried fish was (0.9345, 0.9244) centipoise and (0.9777, 0.9833) centipoise respectively, and it was observed that freezing and salting with drying reduced the viscosity of fish proteins slightly, as this was associated with lower protein susceptibility to Solubility due to the effect of freezing and drying with salting, and the viscosity characteristic of the measured proteins in fish was not affected by cooking methods that used because of the values closely related, and from the statistical results, there were no significant differences at the probability level ($P > 0.05$) for the effect of fish type, the effect of preservation methods, different cooking methods and the interference between them and the fish type in the viscosity values of myofibrillars and sarcoplasmic proteins, and the results generally showed the viscosity values in common carp samples were lower than in silver carp samples which preserved and cooked in different ways. The viscosity of commercial cow's albumin protein reached 0.9430 centipoise which was close to the myofibrillars and sarcoplasm proteins studied.

It has been observed from the results that myofibrillars proteins were less viscosity values than the sarcoplasmic proteins, and that the viscosity was affected by the difference in the type of protein. This may be due to the nature of the protein molecules and the ratio of hydrophobic and hydrophobic acids, mean to the presence of surface forces detesting water [40]. The results of the current study were compatible with the study of [41], which indicated that the viscosity of sarcoplasmic proteins was higher than the viscosity of myofibrillars proteins for both carp and sapoor fish at a concentration of 1% and at laboratory temperature (30 ° C), and this was due to the solubility of these proteins, as the more solubility the viscosity of proteins was increased. The viscosity of the myofibrillars proteins reached to (0.9161 and 0.9452) centipoise, and the viscosity of the sarcoplasmic proteins was (0.9865 and 1.0016) centipoise respectively, for both carp and sapoor.

[42] measured the viscosity of myofibrillars proteins and sarcoplasmic proteins of the fresh sea snake *Mastacembelus armatus* at a concentration of (2.5, 5) mg / ml and its value was (2.3 and 2.5) centipoise and (1.9 and 2.3) centipoise respectively. [30]referred to the viscosity of the total proteins for fresh tilapia was (3.25) centipoise, and [27]explain that the viscosity of myofibrillars proteins and sarcoplasmic proteins for rohu fish at a concentration of (2.5) mg / ml was (4.45, 1.36) centipoise respectively, whereas [33]found that the viscosity of the myofibrillars proteins of fresh samples of common carp and silver carp was (3.29, 13.39) centipoise respectively.

The viscosity values were in frozen mackerel (3926, 1760, 814, 198, 39) centipoise and in cod (4533, 1502, 353, 153, 15 ) centipoise, and it was noted that freezing caused a decrease in viscosity values in general and the percentage of decline in cod was more than In mackerel, this was due to the denaturation resulting from the freezing process [10], and these results are consistent with the current study.

**Table 1.** Functional properties (solubility, water bonding, lipid bonding and viscosity) of common carp and silver carp proteins.

| Fish models | | Functional properties | | | | |
|---|---|---|---|---|---|---|
| | | Protein type | solubility % | water bonding ml water / gm sample | lipid bonding ml oil / gm sample | viscosity centipoise |
| common carp | Fresh | myofibril | 75 | 1.1 | 2.8 | 0.9341 |
| | | sarcoplasmic | 76 | 1.3 | 2.6 | 0.9866 |
| | Frozen for four months | myofibril | 38 | 0.9 | 3.0 | 0.9233 |
| | | sarcoplasmic | 41 | 0.9 | 2.8 | 0.9765 |
| | Salted dried 10% for four months | myofibril | 39 | 1.1 | 2.3 | 0.9076 |
| | | sarcoplasmic | 47 | 1.2 | 2.2 | 0.9794 |
| | Grilling at 300 c for 45 minutes | myofibril | 37 | 1.0 | 2.5 | 0.9100 |
| | | sarcoplasmic | 44 | 1.1 | 2.2 | 0.9854 |
| | Broth at 100 c for 45 minutes | myofibril | 41 | 0.8 | 2.6 | 0.9409 |
| | | sarcoplasmic | 47 | 1.2 | 2.5 | 0.9874 |
| | Frying at 200 c for 45 minutes | myofibril | 36 | 1.1 | 2.4 | 0.9345 |
| | | sarcoplasmic | 45 | 1.1 | 2.2 | 0.9777 |
| silver carp | Fresh | myofibril | 76 | 1.0 | 2.7 | 0.9224 |
| | | sarcoplasmic | 78 | 1.1 | 2.5 | 0.9898 |
| | Frozen for four months | myofibril | 38 | 0.9 | 3.2 | 0.9213 |
| | | sarcoplasmic | 41 | 1.1 | 3.0 | 0.9882 |
| | Salted dried 10% for four months | myofibril | 38 | 1.1 | 2.7 | 0.9453 |
| | | sarcoplasmic | 45 | 1.2 | 2.4 | 0.9876 |
| | Grilling at 300 c for 45 minutes | myofibril | 36 | 0.8 | 2.3 | 0.9254 |
| | | sarcoplasmic | 44 | 1.1 | 2.2 | 0.9882 |
| | Broth at 100 c for 45 minutes | myofibril | 40 | 0.9 | 2.6 | 0.9234 |
| | | sarcoplasmic | 45 | 1.2 | 2.5 | 0.9852 |
| | Frying at 200 c for 45 minutes | myofibril | 35 | 0.9 | 2.5 | 0.9244 |
| commercial protein (cow albumin) | | | 45 | 1.1 | 2.3 | 0.9833 |

All results in the table are repeated.
$LSD_{0.05}$ for the effect of fish type on the solubility of myofibrillars proteins = 1.2 non-significant, $LSD_{0.05}$ for the effect of retention and cooking methods on the solubility of myofibrillars proteins = 2.9
$LSD_{0.05}$ for the effect of interference between fish type and fish models on the solubility of myofibrillars proteins = 8.7
$LSD_{0.05}$ for the effect of fish type on the solubility of sarcoplasmic proteins = 1.4
$LSD_{0.05}$ for the effect of retention methods and cooking methods on the solubility of sarcoplasmic proteins = 4.6
$LSD_{0.05}$ for the effect of interference between fish type, retention methods and cooking methods in the solubility of sarcoplasmic proteins = 34.2
$LSD_{0.05}$ for the effect of fish type on water binding of myofibrillars proteins = 0.3 non-significant, $LSD_{0.05}$ for the effect of retention and cooking methods on binding water to myofibrillars proteins = 0.41
$LSD_{0.05}$ for the effect of interference between fish type, retention methods and cooking methods in binding water to myofibrillars proteins = 0.62 was significant
$LSD_{0.05}$ for the effect of fish type on water binding of sarcoplasmic proteins = 0.20
$LSD_{0.05}$ for the effect of retention and cooking methods in water binding to sarcoplasmic proteins = 0.35
$LSD_{0.05}$ for the effect of interference between fish type, retention methods and cooking methods in binding water to sarcoplasmic proteins = 0.91
$LSD_{0.05}$ for the effect of fish type on the lipid binding of myofibrillars proteins = 0.4
$LSD_{0.05}$ for the effect of retention and cooking methods on lipid binding to myofibrillars proteins = 0.43
$LSD_{0.05}$ for the effect of interference between the fish type, retention methods, and cooking methods for lipid binding to myofibrillars proteins = 0.63
$LSD_{0.05}$ for the effect of fish type on the lipid binding of sarcoplasmic proteins = 0.21
$LSD_{0.05}$ for the effect of retention and cooking methods on lipid binding to sarcoplasmic proteins = 0.36
$LSD_{0.05}$ for the effect of interference between fish type, retention methods and cooking methods in lipid binding to sarcoplasmic proteins = 0.93
$LSD_{0.05}$ for the effect of fish type on viscosity of myofibrillars proteins = 0.0009
$LSD_{0.05}$ for the effect of retention methods and cooking methods in viscosity of myofibrillars proteins = 0.001
$LSD_{0.05}$ for the effect of interference between fish type preservative and cooking methods in viscosity of myofibrillars proteins = 0.003
$LSD_{0.05}$ for the effect of fish type on viscosity of sarcoplasmic proteins = 0.0008
$LSD_{0.05}$ for the effect of retention methods and cooking methods in viscosity of sarcoplasmic proteins = 0.001
$LSD_{0.05}$ for the effect of interference between fish type, retention methods and cooking methods in viscosity of sarcoplasmic proteins = 0.002.

### *3.1.5. Emulsification*

Results are shown in Tables (2), (3), (4), (5), (6) and (7) to the size and stability of the emulsions of the myofibrillars and sarcoplasmic proteins extracted from the samples of common carp and silver carp preserved and cooked in different ways using (1 g protein + 50 ml distilled water + 10 ml corn oil), as it was found through the tables a decrease in the size of the emulsion layer over time, corresponding to an increase in the volume of the water layer, and the stability of the emulsion was monitored after every hour up to 24 hours, and it was observed that the time of emulsification of myofibrillars proteins and sarcoplasmic proteins of fresh samples for common carp and silver carp ranged from 4 seconds to 6 seconds and of (20, 25) seconds and (16 and 18) seconds for myofibrillars and sarcoplasmic proteins for frozen samples of common carp and silver carp, while the time of refraction of emulsion for myofibrillars and sarcoplasmic proteins for both types of dried salted fish was (20, 45) seconds (18, 60) seconds, and the time of emulsion refraction of myofibrillars and sarcoplasmic proteins for grilled samples of common carp and silver carp ranged from (14, 18) seconds to (15, 17) seconds, and from (27 and 28) seconds and (30 and 33) seconds to myofibrillars and sarcoplasmic proteins of broth cooked fish, while the time of emulsion refraction of myofibrillars and sarcoplasmic proteins for fried samples of common carp and silver carp ranged (14.18) second and (15.17) seconds respectively.
From the tables it was clear that the capacity and stability of the emulsions of the myofibrillars proteins was higher than the capacity and the stability of the emulsions of the sarcooplasmic proteins.
The final volume of the emulsion layer for the myofibrillars proteins and sarcoplasmic proteins for fresh samples of common carp and silver carp was (10 and 17) ml and (13 and 15) ml respectively, as was the final volume of the emulsion layer for myofibrillars proteins and sarcoplasmic proteins for frozen samples of common carp and silver carp was (18 and 15) ml and (13 and 12) ml respectively, and it was found that the final volume of the emulsion layer of myofibrillars proteins and sarcoplasmic proteins of salted and dried samples of common carp and silver carp was (11 and 18) ml and (16 and 21) ml respectively, and it was found that freezing reduced the emulsification capacity of the two types of fish protein as for salting and drying, they were raised.

It was observed that the final volume of the emulsion layer of the myofibrillars proteins and sarcoplasmic proteins for grilled samples of common carp and silver carp was (16 and 18) ml and (18 and 19) ml respectively, while the final volume of the emulsion layer of the myofibrillars proteins and sarcoplasmic proteins for cooked in a broth samples of common carp and silver carp was (16 and 15) ml and (21 and 14) ml respectively, as well as the final emulsion layer volume for myofibrillars proteins and sarcoplasmic proteins for fried samples of common carp and silver carp (11 and 14) ml and (12 and 13) ml respectively after 24 hours.

As for the effect of fish type and protein type on the stability of emulsions, it was observed that there was a slight difference in the capacity of emulsions and their stability for myofibrillars proteins as well as for sarcoplasmic proteins, and that the reason for these differences was due to the stability of emulsification increases by increasing the solubility of proteins and decreasing their ability to holding water, as it leads to a strong membrane film formation between the water and oil surfaces, as well as the balance between hydrophilic and hydrophobic proteins [17], and since the studied proteins differ by their solubility, a difference occurs in the amplitude and stability of their emulsions.

The results showed that the volume of the emulsion varies according to the type and source of the protein, as the protein leads to the formation of protein membranes surrounding the oil droplets, which increases the stability of the emulsion [32], and that the stability of the emulsion was affected by the same factors that affect the emulsion composition and these factors were internal, such as the concentration of the emulsifier, the type and concentration of the components of the continuous phase and the diffuse phase and the ratio between them and the viscosity for each. There were other external factors that include stirring and temperature [5].

The results of emulsification of the studied proteins were close to those found by [1]when studying the stability of the emulsion of the myofibrillars and sarcoplasmic proteins of carp and sapoor fish it found that it was (110 and 115) seconds. For sarcooplasmic proteins, the final volume after the same period was 15 ml and 12 ml respectively, and the emulsion refraction time for it was (46 and 55) seconds.

When comparing the results of emulsification of myofibrillars and sarcoplasmic proteins with the results of commercial protein emulsification (cow's albumin), we have found that the final volume of emulsion layer of commercial cow's albumin after 24 hours was 12 ml and the emulsification time of the emulsion was 30 seconds which was closed to the amplitude and stability of emulsification of myofibrillars and sarcoplasmic proteins for fresh, frozen, salted, dried, grilled, brothed and fried samples of common carp and silver carp fish.

From the statistical results, there were significant differences at the probability level ($P \leq 0.05$) for the effect of time on the stability of emulsions of myofibrillars and sarcoplasmic proteins of common carp and silver carp preserved and cooked in different ways. [28]measured the emulsification potential of myofibrillars proteins and sarcoplasmic proteins of the fresh eel fish *Mastacembelus armatus* at a concentration of (2.5, 5) mg / ml and the amount was (2.8 and 2.5) mg / g and (3.1 and 2.2) mg / gm respectively, The time of emulsion refraction was (55, 38) minutes and (60, 40) minutes respectively for both concentrations. [30]explained the stability of the emulsion to the soluble total extracted proteins of fresh tilapia was (124) mg / gm and the time of emulsification of the emulsion was 570 seconds, and [27] noticed that the stability of the emulsion to the myofibrillars and sarcoplasmic proteins for ruho fish at concentration (2.5) mg / ml was (1.09, 11.86) mg / g and the time of refraction of the emulsion was (52, 87) minutes respectively, while [33] found that the emulsion stability of the myofibrillars proteins of fresh samples of common carp and silver carp was (3.10, 7.24) mg / g and the time of emulsion refraction was (53.33, 72.60) minutes respectively, and [14] found that the emulsification potential for catfish proteins was (1.52 ± 0..01) mg / g.

The emulsification values were (48.2, 36.7, 35.5, 36.9, 33.9) mg / ml in mackerel and (53.0, 34.7, 33.4, 34.9, 30.1) mg / ml in cod, and in all samples the emulsification capacity (EC) decreased with the increase in frozen storage time, and the change could be in EC to a large extent, due to loss of protein solubility on the assumption that freezing affects both properties in the same way, the decrease in EC was also due to the denaturation resulting from the freezing process [10].

**Table 2.** The volume and stability of the emulsion for myofibrillars proteins and sarcoplasmic proteins extracted from fresh samples of common carp and silver carp**.**

| Protein type | Stability of emulsion (1 g sample + 50 ml distilled water + 10 ml corn oil) | | | | |
|---|---|---|---|---|---|
| | Time (hour) | common carp | | silver carp | |
| | | Emulsion layer | Water layer | Emulsion layer | Water layer |
| myofibril | zero | 59 | 0 | 57 | 0 |
| | * | 46 | 11 | 47 | 10 |
| | 1 | 37 | 22 | 18 | 39 |
| | 2 | 28 | 31 | 17 | 40 |
| | 3 | 12 | 47 | 17 | 40 |
| | 4 | 12 | 47 | 17 | 40 |
| | 24 | 12 | 47 | 17 | 40 |
| Cream layer refraction time (sec) | | 4* second | | 4 *second | |
| sarcoplasmic | Time (hour) | Emulsion layer | Water layer | Emulsion layer | Water layer |
| | zero | 58 | 0 | 57 | 0 |
| | * | 23 | 34 | 21 | 36 |
| | 1 | 26 | 32 | 15 | 42 |
| | 2 | 19 | 39 | 15 | 42 |
| | 3 | 13 | 45 | 15 | 42 |
| | 4 | 13 | 45 | 15 | 42 |
| | 24 | 13 | 45 | 15 | 42 |
| Cream layer refraction time (sec) | | 6* second | | 6 * second | |
| commercial protein (cow albumin) | Time (hour) | Emulsion layer | | Water layer | |
| | zero | 57 | | 0 | |
| | * | 46 | | 11 | |
| | 1 | 12 | | 45 | |
| | 2 | 12 | | 45 | |
| | 3 | 12 | | 45 | |
| | 4 | 12 | | 45 | |
| | 24 | 12 | | 45 | |
| Cream layer refraction time (sec) | | * second 30 | | | |

Cream layer refraction time (sec)

All results in the table are repeated.

LSD $_{0.05}$ The effect of time on the stability of the emulsion of myofibrillars proteins in fresh common carp = 8.23

LSD $_{0.05}$ for the effect of time on the water layer of myofibrillars proteins in fresh common carp = 8.45

LSD $_{0.05}$ The effect of time on the stability of the emulsion of sarcoplasmic proteins in fresh common carp = 7.0

LSD $_{0.05}$ The effect of time on the water layer in sarcoplasmic proteins in fresh common carp = 6.90

LSD $_{0.05}$ The effect of time on the stability of the emulsion of the myofibrillars proteins in the fresh silver carp fish = 10.0

LSD $_{0.05}$ The effect of time on the water layer of myofibrillars proteins in fresh silver carp = 9.9

LSD $_{0.05}$ The effect of time on the stability of the emulsion of the sarcoplasmic proteins in fresh silver carp = 30.0

LSD $_{0.05}$ The effect of time on the water layer in sarcoplasmic proteins in fresh silver carp fish = 32.0

**Table 3.** The volume and stability of the emulsion for myofibrillars proteins and sarcoplasmic proteins extracted from frozen samples of common carp and silver carp.

| Protein type | Stability of emulsion (1 g sample + 50 ml distilled water + 10 ml corn oil) | | | | |
|---|---|---|---|---|---|
| | Time (hour) | common carp | | silver carp | |
| | | Emulsion layer | Water layer | Emulsion layer | Water layer |
| myofibril | zero | 59 | 0 | 59 | 0 |
| | * | 24 | 35 | 26 | 33 |
| | 1 | 36 | 33 | 20 | 39 |
| | 2 | 28 | 36 | 15 | 44 |
| | 3 | 18 | 41 | 15 | 44 |
| | 4 | 18 | 41 | 15 | 44 |
| | 24 | 18 | 41 | 15 | 44 |
| Cream layer refraction time (sec) | | 20* second | | 16 *second | |
| | Time (hour) | Emulsion layer | Water layer | Emulsion layer | Water layer |
| sarcoplasmic | zero | 58 | 0 | 58 | 0 |
| | * | 27 | 30 | 24 | 34 |
| | 1 | 24 | 34 | 19 | 39 |
| | 2 | 16 | 42 | 12 | 46 |
| | 3 | 13 | 45 | 12 | 46 |
| | 4 | 13 | 45 | 12 | 46 |
| | 24 | 13 | 45 | 12 | 46 |
| Cream layer refraction time (sec) | | 25* second | | 18 * second | |
| | Time (hour) | Emulsion layer | | Water layer | |
| commercial protein (cow albumin) | zero | 57 | | 0 | |
| | * | 46 | | 11 | |
| | 1 | 12 | | 45 | |
| | 2 | 12 | | 45 | |
| | 3 | 12 | | 45 | |
| | 4 | 12 | | 45 | |
| | 24 | 12 | | 45 | |
| Cream layer refraction time (sec) | | * second 30 | | | |

Cream layer refraction time (sec)

All results in the table are repeated.

$LSD_{0.05}$ The effect of time on the stability of the emulsion of the myofibrillars proteins in the frozen common carp = 6.9

$LSD_{0.05}$ for the effect of time on the water layer of the myofibrillars proteins in frozen common carp fish = 8.0

$LSD_{0.05}$ The effect of time on the stability of the emulsion of sarcoplasmic proteins in frozen common carp fish = 11.0

$LSD_{0.05}$ for the effect of time on the water layer in sarcoplasmic proteins in frozen common carp = 10.2

$LSD_{0.05}$ The effect of time on the stability of the emulsion of the myofibrillars proteins in the frozen silver carp fish = 5.4

$LSD_{0.05}$ The effect of time on the water layer of the myofibrillars proteins in frozen silver carp = 6.2

$LSD_{0.05}$ The effect of time on the stability of the emulsion of sarcoplasmic proteins in frozen silver carp fish = 11.8

$LSD_{0.05}$ The effect of time on the water layer in sarcoplasmic proteins in frozen silver carp fish = 11.9

**Table 4.** The volume and stability of the emulsion for myofibrillars proteins and sarcoplasmic proteins extracted from salted dried samples of common carp and silver carp.

| Protein type | Stability of emulsion (1 g sample + 50 ml distilled water + 10 ml corn oil) | | | | |
|---|---|---|---|---|---|
| | Time (hour) | common carp | | silver carp | |
| | | Emulsion layer | Water layer | Emulsion layer | Water layer |
| myofibril | zero | 59 | 0 | 59 | 0 |
| | * | 36 | 33 | 36 | 23 |
| | 1 | 24 | 36 | 24 | 35 |
| | 2 | 11 | 47 | 18 | 41 |
| | 3 | 11 | 47 | 18 | 41 |
| | 4 | 11 | 47 | 18 | 41 |
| | 24 | 11 | 47 | 18 | 41 |
| Cream layer refraction time (sec) | | 20* second | | 18 *second | |
| | Time (hour) | Emulsion layer | Water layer | Emulsion layer | Water layer |
| sarcoplasmic | zero | 58 | 0 | 58 | 0 |
| | * | 28 | 30 | 49 | 9 |
| | 1 | 22 | 36 | 25 | 33 |
| | 2 | 16 | 42 | 21 | 37 |
| | 3 | 16 | 42 | 21 | 37 |
| | 4 | 16 | 42 | 21 | 37 |
| | 24 | 16 | 42 | 21 | 37 |
| Cream layer refraction time (sec) | | 45* second | | 60 * second | |
| | Time (hour) | Emulsion layer | | Water layer | |
| commercial protein (cow albumin) | zero | 57 | | 0 | |
| | * | 46 | | 11 | |
| | 1 | 12 | | 45 | |
| | 2 | 12 | | 45 | |
| | 3 | 12 | | 45 | |
| | 4 | 12 | | 45 | |
| | 24 | 12 | | 45 | |
| Cream layer refraction time (sec) | | * second 30 | | | |

Cream layer refraction time (sec)
All results in the table are repeated.
$LSD_{0.05}$ The effect of time on the stability of the emulsion of myofibrillars proteins in dried salted common carp = 12.0
$LSD_{0.05}$ The effect of time on the water layer of myofibrillars proteins in salted dried common carp. = 11.0
$LSD_{0.05}$ The effect of time on the stability of the emulsion of sarcoplasmic proteins in dried salted common carp = 11.7
$LSD_{0.05}$ The effect of time on the water layer of sarcoplasmic proteins in dried salted commoncarp = 11.9
$LSD_{0.05}$ The effect of time on the stability of the emulsion of myofibrillars proteins in dried salted silver carp fish = 19.6
$LSD_{0.05}$ The effect of time on the water layer of myofibrillars proteins in salted dried silver carp = 12.0
$LSD_{0.05}$ The effect of time on the stability of the emulsion of sarcoplasmic proteins in dried salted silver carp fish = 21.0
$LSD_{0.05}$ The effect of time on the water layer in sarcoplasmic proteins in dried salted silver carp fish = 6.7

**Table 5.** The volume and stability of the emulsion for myofibrillars proteins and sarcoplasmic proteins extracted from grilled samples of common carp and silver carp.

| Protein type | Stability of emulsion (1 g sample + 50 ml distilled water + 10 ml corn oil) | | | | |
|---|---|---|---|---|---|
| | Time (hour) | common carp | | silver carp | |
| | | Emulsion layer | Water layer | Emulsion layer | Water layer |
| myofibril | zero | 59 | 0 | 59 | 0 |
| | * | 30 | 29 | 31 | 28 |
| | 1 | 19 | 40 | 18 | 41 |
| | 2 | 16 | 43 | 18 | 41 |
| | 3 | 16 | 43 | 18 | 41 |
| | 4 | 16 | 43 | 18 | 41 |
| | 24 | 16 | 43 | 18 | 41 |
| Cream layer refraction time (sec) | | 14* second | | 15 *second | |
| | Time (hour) | Emulsion layer | Water layer | Emulsion layer | Water layer |
| sarcoplasmic | zero | 58 | 0 | 58 | 0 |
| | * | 26 | 32 | 25 | 33 |
| | 1 | 21 | 37 | 19 | 39 |
| | 2 | 18 | 40 | 19 | 39 |
| | 3 | 18 | 40 | 19 | 39 |
| | 4 | 18 | 40 | 19 | 39 |
| | 24 | 18 | 40 | 19 | 39 |
| Cream layer refraction time (sec) | | 18* second | | 17 * second | |
| | Time (hour) | Emulsion layer | | Water layer | |
| commercial protein (cow albumin) | zero | 57 | | 0 | |
| | * | 46 | | 11 | |
| | 1 | 12 | | 45 | |
| | 2 | 12 | | 45 | |
| | 3 | 12 | | 45 | |
| | 4 | 12 | | 45 | |
| | 24 | 12 | | 45 | |
| Cream layer refraction time (sec) | | * second 30 | | | |

Cream layer refraction time (sec)
All results in the table are repeated.
LSD $_{0.05}$ The effect of time on the stability of the emulsion of the myofibrillars proteins in the grilled common carp fish = 11.0
LSD $_{0.05}$ The effect of time on the water layer of myofibrillars proteins in grilled common carp = 10.9
LSD $_{0.05}$ The effect of time on the stability of the emulsion of sarcooplasmic proteins in grilled carp fish = 10.7
LSD $_{0.05}$ for the effect of time on the water layer of sarcooplasmic proteins in grilled common carp fish = 10.5
LSD $_{0.05}$ The effect of time on the stability of the emulsion of the myofibrillars proteins in the grilled silver carp = 12.3
LSD $_{0.05}$ for the effect of time on the water layer of myofibrillars proteins in grilled silver carp = 11.8
LSD $_{0.05}$ The effect of time on the stability of the emulsion of sarcooplasmic proteins in grilled silver carp fish = 32.1
LSD $_{0.05}$ The effect of time on the water layer in sarcoplasm proteins in grilled silver carp fish = 32.6 cooked in broth

**Table 6.**The volume and stability of the emulsion for myofibrillars proteins and sarcoplasmic proteins extracted from cooked in broth samples of common carp and silver carp.

| Protein type | Stability of emulsion (1 g sample + 50 ml distilled water + 10 ml corn oil) | | | | |
|---|---|---|---|---|---|
| | Time (hour) | common carp | | silver carp | |
| | | Emulsion layer | Water layer | Emulsion layer | Water layer |
| myofibril | zero | 59 | 0 | 58 | 0 |
| | * | 40 | 19 | 39 | 19 |
| | 1 | 22 | 37 | 22 | 36 |
| | 2 | 16 | 43 | 15 | 43 |
| | 3 | 16 | 43 | 15 | 43 |
| | 4 | 16 | 43 | 15 | 43 |
| | 24 | 16 | 43 | 15 | 43 |
| Cream layer refraction time (sec) | | 27* second | | 30 *second | |
| | Time (hour) | Emulsion layer | Water layer | Emulsion layer | Water layer |
| sarcoplasmic | zero | 57 | 0 | 57 | 0 |
| | * | 49 | 8 | 25 | 32 |
| | 1 | 25 | 32 | 16 | 41 |
| | 2 | 21 | 36 | 14 | 43 |
| | 3 | 21 | 36 | 14 | 43 |
| | 4 | 21 | 36 | 14 | 43 |
| | 24 | 21 | 36 | 14 | 43 |
| Cream layer refraction time (sec) | | 28* second | | 33 * second | |
| | Time (hour) | Emulsion layer | | Water layer | |
| commercial protein (cow albumin) | zero | 57 | | 0 | |
| | * | 46 | | 11 | |
| | 1 | 12 | | 45 | |
| | 2 | 12 | | 45 | |
| | 3 | 12 | | 45 | |
| | 4 | 12 | | 45 | |
| | 24 | 12 | | 45 | |
| Cream layer refraction time (sec) | | * second 30 | | | |

Cream layer refraction time (sec)
All results in the table are repeated.
LSD $_{0.05}$ The effect of time on the stability of the emulsion of myofibrillars proteins in common carp cooked in broth = 19.0
LSD $_{0.05}$ for the effect of time on the water layer of myofibrillars proteins in common carp cooked broth = 18.0
LSD0.05 The effect of time on the stability of the emulsion of sarcooplasmic proteins in common carp cooked in broth = 7.9
LSD $_{0.05}$ for the effect of time on the water layer of sarcooplasmic proteins in common carp cooked in broth = 7.5
LSD $_{0.05}$ The effect of time on the stability of the emulsion of the myofibrillars proteins in silver carp cooked in broth = 7.0
LSD $_{0.05}$ for the effect of time on the water layer of myofibrillars proteins in silver carp cooked in broth = 6.6
LSD $_{0.05}$ The effect of time on the stability of the emulsion of sarcooplasmic proteins in silver carp cooked in broth = 8.6
LSD $_{0.05}$ for the effect of time on the water layer of sarcooplasmic proteins in silver carp cooked in broth = 8.8

**Table 7.** The volume and stability of the emulsion for myofibrillars proteins and sarcoplasmic proteins extracted from fried samples of common carp and silver carp.

| Protein type | Stability of emulsion (1 g sample + 50 ml distilled water + 10 ml corn oil) | | | | |
|---|---|---|---|---|---|
| | Time (hour) | common carp | | silver carp | |
| | | Emulsion layer | Water layer | Emulsion layer | Water layer |
| myofibril | zero | 59 | 0 | 58 | 0 |
| | * | 19 | 38 | 24 | 34 |
| | 1 | 13 | 44 | 14 | 44 |
| | 2 | 11 | 46 | 14 | 44 |
| | 3 | 11 | 46 | 14 | 44 |
| | 4 | 11 | 46 | 14 | 44 |
| | 24 | 11 | 46 | 14 | 44 |
| Cream layer refraction time (sec) | | 3* second | | 4 *second | |
| | Time (hour) | Emulsion layer | Water layer | Emulsion layer | Water layer |
| sarcoplasmic | zero | 58 | 0 | 57 | 0 |
| | * | 21 | 37 | 22 | 35 |
| | 1 | 15 | 43 | 13 | 44 |
| | 2 | 12 | 46 | 13 | 44 |
| | 3 | 12 | 46 | 13 | 44 |
| | 4 | 12 | 46 | 13 | 44 |
| | 24 | 12 | 46 | 13 | 44 |
| Cream layer refraction time (sec) | | 5* second | | 6 * second | |
| | Time (hour) | Emulsion layer | | Water layer | |
| commercial protein (cow albumin) | zero | 57 | | 0 | |
| | * | 46 | | 11 | |
| | 1 | 12 | | 45 | |
| | 2 | 12 | | 45 | |
| | 3 | 12 | | 45 | |
| | 4 | 12 | | 45 | |
| | 24 | 12 | | 45 | |
| Cream layer refraction time (sec) | | * second 30 | | | |

Cream layer refraction time (sec)
All results in the table are repeated.
LSD0.05 The effect of time on the stability of the emulsion of the myofibrillars proteins in fried common carp = 6.9
LSD $_{0.05}$ for the effect of time on the water layer of the myofibrillars proteins in fried common carp = 7.1
LSD $_{0.05}$ The effect of time on the stability of the emulsion of sarcooplasmic proteins in fried common carp = 8.6
LSD $_{0.05}$ The effect of time on the water layer in sarcooplasmic proteins in fried common carp = 8.0
LSD $_{0.05}$ The effect of time on the stability of the emulsion of the myofibrillars proteins of the fried silver carp = 10.0
LSD $_{0.05}$ The effect of time on the water layer of the myofibrillars proteins in fried silver carp = 9.4
LSD $_{0.05}$ The effect of time on the stability of the emulsion of sarcooplasmic proteins in fried silver carp = 9.2
LSD $_{0.05}$ The effect of time on the water layer of sarcooplasmic proteins in fried silver carp = 9.0

### *3.1.6. Gelatinization*

The results of this study showed the gelatinization properties of myofibrillars proteins and sarcoplasmic proteins in different concentrations ranging from 1-15% extracted from the samples of common carp and silver carp preserved in different methods and cooked with different methods.
Fibrous proteins from fresh, frozen and salted dried common and silver carp were not jelly until the concentration was 15%, while sarcoplasmic proteins from fresh, frozen and salted dried common and silver carp formed a weak gel at a concentration of 5% and an average gel at a concentration of 10% and formed strong gel at a concentration of 15%, as the lowest concentration needed to form the gel for these proteins was 5%.
Concerning the effect of different cooking methods, it was found that the myofibrillars proteins of the grilled common carp formed a weak gel at a concentration of 15%, while the myofibrillars proteins of the grilled silver carp had formed a weak gel at a concentration of 10%, and an average gel at a concentration of 15%, while the sarcoplasmic proteins of the grilled samples of common carp and silver carp made a weak gel at 10% concentration and an average gel at 15% concentration.
When using the broth method in cooking common carp and silver carp and measuring their ability to form gel, it was noted that myofibrillars proteins gave weak gel at 10% concentration, medium gel at 15% concentration, while sarcoplasmic

proteins for common carp and silver carp gave weak gel at 5% concentration and gel average at 10% concentration, strong gel at 15% concentration, myofibrillars proteins and sarcoplasmic proteins for fried samples of common carp and silver carp formed weak gel at 10% concentration and medium gel at 15% concentration.

**Table 8.** The ability of gel formation for myofibrillars proteins and sarcoplasmic proteins extracted from common and silver carp samples.

| Fish models | | | concentration% | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Protein type | 1 | 3 | 5 | 10 | 15 |
| common carp | | Fresh | myofibril | - | - | - | - | + |
| | | | sarcoplasmic | - | - | + | ++ | +++ |
| | | Frozen for four months | myofibril | - | - | - | - | + |
| | | | sarcoplasmic | - | - | + | ++ | +++ |
| | | Salted dried 10% for four months | myofibril | - | - | - | - | + |
| | | | sarcoplasmic | - | - | + | ++ | +++ |
| | Cooked | Grilling at 300 c for 45 minutes | myofibril | - | - | - | - | + |
| | | | sarcoplasmic | - | - | - | + | ++ |
| | | Broth at 100 c for 45 minutes | myofibril | - | - | - | + | ++ |
| | | | sarcoplasmic | - | - | + | ++ | +++ |
| | | Frying at 200 c for 45 minutes | myofibril | - | - | - | + | ++ |
| | | | sarcoplasmic | - | - | - | + | ++ |
| silver carp | | Fresh | myofibril | - | - | - | - | + |
| | | | sarcoplasmic | | | + | ++ | +++ |
| | | Frozen for four months | myofibril | - | - | - | - | + |
| | | | sarcoplasmic | - | - | + | ++ | +++ |
| | | Salted dried 10% for four months | myofibril | - | - | - | - | + |
| | | | sarcoplasmic | - | - | + | ++ | +++ |
| | Cooked | Grilling at 300 c for 45 minutes | myofibril | - | - | - | + | ++ |
| | | | sarcoplasmic | - | - | + | ++ | +++ |
| | | Broth at 100 c for 45 minutes | myofibril | - | - | - | + | ++ |
| | | | sarcoplasmic | - | - | + | ++ | +++ |
| | | Frying at 200 c for 45 minutes | myofibril | - | - | - | + | ++ |
| | | | sarcoplasmic | - | - | - | + | ++ |
| commercial protein (cow albumin) | | | | - | + | ++ | ++ | +++ |

No gel formation -
\+ Weak gel
++ Medium gel
++ + Strong gel

No notable differences were observed between myofibrillars proteins and sarcoplasmic proteins for the two fish species in their ability to form gel due to the effect of preserving methods and cooking methods under study, In general, its ability to gel was unimaginable and increased by increasing the concentration of fish protein, and the susceptibility of sarcoplasmic proteins exceeds that of the myofibrillars proteins in gel formation.

When comparing the susceptibility to myofibrillars proteins and sarcoplasmic proteins to gel formation with susceptibility to commercial cow's albumin, we find that the latter began to form gel beginning with a concentration of 3%, which was better than fish proteins in this characteristic.

The inability of the myofibrillars proteins to form the gel was due to the presence of some factors that cause the breakdown of the sulfur bonds, and factors that cause weak hydrogen bonding and hydrophobic bonding, this was mentioned by [29] in their study of the gelatinization properties of plasma proteins, as the reason for this varies due to their amino acids (proline and hydroxyprolene that hates water), as their presence was lower in fish proteins, which leads to their limited ability to form gel, as well as the difference In the hydrogen bonds that attribute stability, strength and susceptibility to gel formation by reserving water in a three-dimensional network [12].

[14]The catfish proteins had the ability to form gel at a concentration of 5% (w / volume), and [1] studied the gel volume and persistence of the myofibrillars and sarcoplasmic proteins of sapoor and common carp, and indicated that the myofibrillars proteins of carp and sapoor fish did not formed gel until concentration was 15%, while sarcoplasmic proteins for carp and sapoor fish form gel, and the lowest concentration required for gel formation for these proteins was 13% and 12% respectively. In comparing the susceptibility to myofibrillars proteins and sarcoplasmic proteins to gel formation with the susceptibility of commercial cow's albumin, it was found that the latter began to form gel starting from the 4% concentration, outperforming fish proteins in this characteristic.

[28] measured the gel strength of fresh eel *Mastacembelus armatus* was about 250 g.cm, In similar studies, [30]found that the gel strength of fresh tilapia fish was 710 g.cm, while [33]found that the gel strength of fresh samples of common carp and silver carp was (166.16,180.19)% respectively.
It turned out that the current study differs in its results with the studies carried out in this field.

### *3.1.7. Foaming ability*

The results are shown in Table (4-10) and Table (4-11) the foam properties of myofibrillars proteins and sarcoplasmic proteins extracted from common carp and silver carp samples preserved with different preservation methods as well as cooked with different cooking methods at a concentration of 1% and for different values of pH and for time periods (0.20, 30, 60) minutes, as it turns out that the sarcoplasmic proteins of common carp and silver carp gave more volume and consistency in the foam than myofibrillars proteins, because the foam was affected by the difference in the type of protein, and the reason may be due to the nature of the protein molecules and the proportion of hateful amino acids of water and hydrophilic, that was, to the presence of surface forces detesting water [23]. The results indicated that there are differences in the volume and stability of foam between the myofibrillars proteins and sarcoplasmic, and the decrease in the volume of the foam and its stability at pH 9, and its height whenever we move away from this number, as found through this study that the volume of the foam decreases with the progress of time and does not fade and this was consistent with what [42]found her when she studied the foam properties of two food grade and technical grade fish owls from both catfish and rough.
The degree of influence of the measured foam property in myofibrillars and sarcoplasmic proteins of fish species by different methods of preservation and cooking methods was minimal because the values were closely related, and we did not find a specific pattern that we could apply in terms of determining the degree of difference, freezing and salting with drying sometimes raises the ability to form foam and others reduce it, as well as grillling, frying and cooking in a broth, perhaps due to the effect of the internal chemical composition of fish muscle proteins, which was a very complex and sensitive system at the same time its properties were affected by the amount and proportions of the compounds formed after decomposition and It was worth mentioning the increasing the volume of the foam and increases stability increased focus and increase the time [13,31].

**Table 9.** The ability to formed foam for myofibrillars and sarcoplasmic proteins extracted from common carp

| Fish models | | | Foam volume (ml) at time (min | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Protein type | pH | 0 | 10 | 20 | 30 | 60 |
| common carp | Fresh | myofibril | 4 | 193 | 146 | 116 | 105 | 88.7 |
| | | | 7 | 168 | 127 | 98 | 89 | 88 |
| | | | 9 | 116.2 | 73.3 | 64 | 53 | 50 |
| | | sarcoplasmic | 4 | 265 | 248 | 218.6 | 193.4 | 138 |
| | | | 7 | 262 | 244 | 215 | 190 | 134 |
| | | | 9 | 172 | 154 | 130 | 77 | 26 |
| | Frozen for four months | myofibril | 4 | 168 | 128 | 100 | 90.3 | 87.2 |
| | | | 7 | 164 | 125 | 96 | 86 | 84 |
| | | | 9 | 113 | 70 | 61 | 50 | 47 |
| | | sarcoplasmic | 4 | 261.8 | 244.2 | 215.5 | 203 | 134.4 |
| | | | 7 | 258 | 241 | 212 | 188 | 132 |
| | | | 9 | 169 | 151 | 129 | 74 | 24 |
| | Salted dried 10% for four months | myofibril | 4 | 175.4 | 134 | 104 | 95.2 | 93 |
| | | | 7 | 172 | 130 | 102 | 92 | 90 |
| | | | 9 | 111 | 67 | 58 | 47 | 43 |
| | | sarcoplasmic | 4 | 268.7 | 251.2 | 219.3 | 195.7 | 139 |
| | | | 7 | 265 | 247 | 216 | 192 | 136 |
| | | | 9 | 168 | 150 | 127 | 73 | 23 |
| Cooked | Grilling at 300 c for 45 minutes | myofibril | 4 | 168 | 129 | 100 | 91 | 89.2 |
| | | | 7 | 166 | 125 | 96 | 87 | 85 |
| | | | 9 | 115 | 71 | 62 | 51 | 48 |
| | | sarcoplasmic | 4 | 263 | 245.8 | 215 | 191.2 | 134.9 |
| | | | 7 | 260 | 242 | 187 | 132 | 118 |
| | | | 9 | 170 | 152 | 129 | 75 | 24 |

### *3.1.7.1 .Foam ability of myofibrillars and sarcoplasmic proteins from common carp.*

At the pH = (4, 7, 9) the highest foam volume of the myofibrillars proteins of the fresh common carp reached to (193, 168, 116.2) ml respectively at the time (0) minutes while the lowest foam volume for these proteins was (88.7, 88 and 70) ml respectively, after 60 minutes, with respect to sarcoplasmic proteins, the highest foam volume for sarcoplasmic proteins of fresh common carp (265, 262, 172) ml was respectively at the time (0) minutes, while the lowest foam volume for these proteins (138, 134 and 26) ml was respectively after 60 minutes.

**Table 10.** The ability to formed foam for myofibrillars and sarcoplasmic proteins extracted from silver carp.

| Fish models | | | Foam volume (ml) at time (min | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Protein type | pH | 0 | 10 | 20 | 30 | 60 |
| silver carp | Fresh | myofibril | 4 | 195 | 149 | 119 | 107 | 101 |
| | | | 7 | 173 | 130 | 100 | 93 | 90 |
| | | | 9 | 118 | 75 | 66 | 55 | 52 |
| | | sarcoplasmic | 4 | 265 | 228 | 221 | 196 | 140 |
| | | | 7 | 264 | 225 | 217 | 192 | 136 |
| | | | 9 | 174 | 156 | 133 | 79 | 28 |
| | Frozen for four months | myofibril | 4 | 176 | 132 | 101 | 94 | 91 |
| | | | 7 | 172 | 128 | 98 | 91 | 89 |
| | | | 9 | 117 | 73 | 63 | 51 | 49 |
| | | sarcoplasmic | 4 | 268 | 226.8 | 118.5 | 194 | 138.8 |
| | | | 7 | 292 | 224 | 215 | 191 | 134 |
| | | | 9 | 172 | 154 | 130 | 77 | 27 |
| | Salted dried 10% for four months | myofibril | 4 | 170 | 124 | 94 | 86 | 89 |
| | | | 7 | 165 | 120 | 90 | 83 | 86 |
| | | | 9 | 176 | 68 | 59 | 47 | 49 |
| | | sarcoplasmic | 4 | 264 | 238 | 214 | 184 | 138 |
| | | | 7 | 260 | 235 | 210 | 180 | 135 |
| | | | 9 | 170 | 124 | 94 | 86 | 89 |
| Cooked | Grilling at 300 c for 45 minutes | myofibril | 4 | 190 | 133 | 102 | 94 | 95 |
| | | | 7 | 175 | 130 | 99 | 91 | 90 |
| | | | 9 | 116 | 71 | 60 | 51 | 47 |
| | | sarcoplasmic | 4 | 269 | 226 | 220 | 194 | 140 |
| | | | 7 | 190 | 133 | 102 | 94 | 95 |
| | | | 9 | 175 | 130 | 99 | 91 | 90 |
| | Broth at 100 c for 45 minutes | myofibril | 4 | 174 | 131 | 101 | 94.7 | 90.5 |
| | | | 7 | 169 | 128 | 97 | 91 | 88 |
| | | | 9 | 112 | 68 | 57 | 48 | 47 |
| | | sarcoplasmic | 4 | 264 | 227 | 219 | 137 | 136 |
| | | | 7 | 261 | 223 | 216 | 191 | 135 |
| | | | 9 | 168 | 147 | 126 | 72 | 25 |
| | Frying at 200 c for 45 minutes | myofibril | 4 | 179 | 135 | 107 | 98 | 95 |
| | | | 7 | 175 | 133 | 103 | 95 | 93 |
| | | | 9 | 122 | 80 | 70 | 62 | 57 |
| | | sarcoplasmic | 4 | 270 | 229 | 223 | 197 | 142 |
| | | | 7 | 266 | 226 | 220 | 194 | 138 |
| | | | 9 | 179 | 160 | 138 | 84 | 32 |
| | commercial protein (cow albumin) | | 7 | 250 | 200 | 192 | 175 | 170 |

As for frozen carp samples, it was observed that the highest foam volume was (168, 164 and 113) ml respectively, at the time (0) minutes for the myofibrillars proteins, while the lowest foam volume for these proteins was (87.2, 84 and 47) ml respectively, after 60 minutes passed, The highest and lowest foam volumes for sarcoplasmic proteins were (261.8, 258, 169) ml and (134.4, 132, 24) ml respectively at the time (0, 60) minutes and at the pH (4, 7, 9), and reached higher foam volume of the salted and dried common carp (175.4, 172, 111) ml respectively, at time (0) min, while the lowest foam volume for these proteins (93, 90, 43) ml respectively after 60 minutes, with regard to sarcoplasmic proteins, the highest foam volume for sarcoplasmic proteins of salted and dried common carp was (268.7, 265, and 168) ml respectively at time (0) minutes, while the lowest foam volume for these proteins was (139, 136 and 23) ml respectively after 60 minutes have passed at pH = (4, 7, 9).

In grilled common carp samples, it was observed that the highest foam volume was (168, 166, 115) ml respectively, at the time (0) minutes for the myofibrillars proteins, while the lowest foam volume for these proteins were (89.2, 85, and 48) ml respectively, after passed 60 minutes. The highest and lowest foam volume for sarcoplasmic proteins were (263, 260, 170) ml and (134.9, 118, 24) ml respectively at the time (0, 60) minutes and at pH (4, 7, 9), and it was found that the foam volume of the myofibrillars and sarcoplasmic proteins of common carp cooked in broth were (168, 165, 111) ml and (263.7, 259, 167) ml respectively after (0) minutes, while the values of it for myofibrillars and sarcoplasmic proteins were (88.5, 86.46 ml) and (135.5 133: 21) ml respectively after 60 minutes and when the numbers of hydrogen (4, 7 and 9).

The results also showed that the foam volume of myofibrillars and sarcoplasmic proteins of fried common carp were about (175, 171, 119) ml and (270, 266, 176) ml respectively after the passage of (0) minute, but in the f myofibrillars and sarcoplasmic proteins of the grilled fish, the volume of foam formed was about (94, 91, 54) ml and (142, 138 and 30) ml respectively, after 60 minutes at the pH = (4, 7, 9).

### *3.1.7. 2.Foam ability of myofibrillars and sarcoplasmic proteins from silver carp.*

This study indicated that the highest foam volume was (195, 173 and 118) ml respectively, at the time (0) minutes in the myofibrillars proteins for fresh samples of silver carp, while the lowest foam volume for these proteins was (101, 90 and 52) ml respectively after 60 minutes, the highest and lowest foam volumes of sarcoplasmic proteins were (265, 264, 174) ml and (140, 136, 28) ml respectively at time (0, 60) minutes and at pH (4, 7, 9).

At the pH = (4, 7, 9) reached the highest foam volume of the frozen silver carp proteins (176, 172 and 117) ml respectively at the time (0) minutes, while the lowest foam volume for these proteins was (91, 89 and 49 ) ml respectively, after 60 minutes have passed. With respect to sarcolasmic proteins, the highest foam volume for these proteins was for frozen silver carp (268, 292, 172) ml respectively at time (0) minutes, while the lowest foam volume for these proteins was (138.8. ,134 and 27) ml respectively after 60 minutes. In dried salted samples of silver carp, it was observed that the highest foam volume was (170, 165, 116) ml respectively at the time (0) minutes for the myofibrillars proteins, while the lowest foam volume for these proteins was (89, 86 and 49) ml, respectively, after 60 minutes, the highest and lowest foam volumes of sarcoplasmic proteins (264, 260, 176) were (138.135, 28) ml respectively at the time (.60) minutes and when the numbers of hydrogen (4, 7 and 9).

At pH = (4, 7, 9) the highest foaming volume of the myofibrillars proteins of the gilled silver carp was (190, 175, 116) respectively at the time (0) minutes while the lowest foam volume for these proteins was (95, 90, 47) ml respectively after 60 minutes, and with respect to sarcoplasmic proteins, the highest foam volume for sarcoplasm proteins of dried salted samples of silver carp were (269, 265, 170) ml respectively at the time (0) minutes, while the lowest foam volume for these proteins were (140, 136 and 23) ml respectively after 60 minutes, it was found that the foam volume of myofibrillars and sarcoplasmic proteins of silver carp cooked in broth were (174, 169, 112) ml and (264, 261, 168) ml respectively after (0) minutes had passed, while their values for myofibrillars and sarcoplasmic proteins were (90.5, 88, 47) ml and (136, 135, 25) ml respectively, after 60 minutes and at pH (4, 7, 9), foaming volumes of respectively,of fried silver carp were also measured (179, 175, 122) ml and (270, 266, 179) ml respectively, after (0) minutes passed, but in the myofibrillars and sarcoplasmic proteins of fried silver carp fish the volume of foam formed was about (95, 93, 57) ml and (142, 138 and 32) ml respectively after 60 minutes at the pH = (4, 7, 9).

In comparing the foam properties of the myofibrillars and sarcoplasmic proteins of common carp and silver carp with commercial cow's albumin at a concentration of 1% and at the normal pH = 7, it was found that the foam size and persistence of the sarcoplasmic proteins were close to the volume and stability of the foam for the commercial protein at the normal pH, while the volume and the stability of the foam to the myofibrillars proteins was slightly lower than for cow's albumin.

This result was consistent with [3]who found that in studying the foam properties of the protein which concentrates the *Chirocentvus dorab* fish, as reported by [1]that there were few differences in the volume and firmness of the foam between the myofibrillars and sarcoplasmic proteins of sapoor and common carp, and indicated that the foam volume decreased and fixed at the number of pH= 9 for myofibrillars and sarcoplasmic

proteins for both types of fish, and their height whenever we move away from this number, has a minimum volume of (155 and 105) ml for myofibrillars proteins and (170 and 150) ml for sarcoplasmic proteins for carp and sapoor fish respectively, and that the highest volume of foam and more persistent was at a PH 4, which stood (195 and 175) ml of myofibrillars proteins and 300 ml of sarcoplasmic proteins for both types of fish respectively. [28]measured the foam for myofibrillars proteins and sarcoplasmic proteins for fresh eel *Mastacembelus armatus* at a concentration of (2.5, 5) mg / ml and it was (3.1 and 3) % and ( 2.4 and 2.3) % respectively.

[27]explain that the foam for the myofibrillars proteins and sarcoplasmic proteins for ruho fish at a concentration of (2.5) mg / ml was (105.33, 41.33) % respectively, while [33]found that the ability to form the foam for the myofibrillars proteins for fresh samples of common carp and silver carp was (50, 60) % respectively, and [14]found that the ability to form foams for catfish proteins was (0.89 ± 0.11) mg / ml.

## Conclusions

It is obviously that:

1. The results of the statistical analysis showed that there was a significant effect of fish type, preservation methods, cooking methods and binary interaction at the probability level ($P \leq 0.05$) on the functional properties of fibrils proteins and sarcoplasmic proteins separated from them.
2. The fibrous and sarcoplasmic proteins of the studied meat gave good functional properties compared to the commercial bovine albumin.

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