Study of the qualitative characteristics of carp surimi powder frozen for different periods

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Abstract

In this study, the qualitative properties of surimi fish powder produced from storing carp fish in a freezer at -18°C for (0, 2, 4, 6, 8, 10, 12, 14) days were studied, and the chemical composition of the powder was tested, including protein content, oil absorption capacity, density, emulsification and emulsion stability, thiobarbituric acid content, and gelatinous ability. The results showed that increasing the freezing time of fish led to an increase in the values of thiobarbituric acid and an increase in density, and a decrease in other qualitative properties, such as protein solubility, the ability to form powder gel, and the oil absorption capacity. It can be said that long-term storage of carp in freezing led to a decrease in the quality properties of the surimi powder produced.

Keywords: Carp, Surimi fish powder, Qualitative characteristics, Freezing-18.

Introduction

Fish protein is considered a very good source of essential amino acids, and it also has practical properties in gel and emulsion formation, especially in the food industry Carp is an important fish that is cultured in a large number of fish farming systems, due to its rapid growth, low production cost, and resistance to stress and diseases [1,2]. Carp is considered a competitive fish to many other known fish [3]. Fish are generally considered to be under-consumed, so it is important to produce various food and non-food products from these fish to enhance their consumption and benefit from them. One of the products with high nutritional value in the world is surimi fish, which is minced fish meat that has been separated manually or mechanically from the bones, and most of the soluble compounds in it have been removed by the washing process [4]. The benefits of surimi powder include its low price, ease of mixing with other materials, and ease of handling and distribution It is stored at room temperature and requires a small storage space [5]. The protein level in surimi powder is higher than that found in regular fish meat [5, 6]. There are several different methods for preparing and drying surimi powder, which depend on the required quality of surimi. We mention some of these methods, including sublimation drying, oven drying, chemical method, and spray drying. The method of using sublimation drying is considered one of the best methods for its production. One of the important things in the production of surimi

powder is removing most of the water in it to obtain a dry powder with a low microbial and enzymatic load. Carp is a low-fat fish and a very suitable species for the production of surimi fish powder. The quality of surimi fish powder depends on several factors such as the fat content of the fish, the protein content which represents the quality of the raw material, the drying method and the amount of additives [7]. The quality of the raw materials is one of the most important things in the process of producing surimi fish protein powder [8 ,9]. Failure to adhere to the temperatures of storing fish after catching can lead to a decrease in the level of the final product of surimi fish. Therefore, storage at low temperatures, especially storage in ice, is one of the most appropriate ways to cool fish and preserve it from spoilage [10].

Materials and Methods

Apparatus and materials used

Freeze drying device, Kjeldahl apparatus, Soxhlet apparatus, Spectrophotometer, Meat grinder, Incubator, Carp fish, Palm oil (food grade), Sorbitol, Polyphosphate, Boric acid, Sulfuric acid, Hydrochloric acid, Table salt, Methyl red reagent, Sodium hydroxide, Thiobarbital acid reagent, Butanol, Petroleum ether.

Surimi fish powder preparation

To produce surimi powder from carp fish with an average weight of (1500) g, carp fish were caught from the Euphrates River in the city of Saddat Al-Hindiya. After washing the fish with clean cold water, they were placed completely in the middle of ice in suitable isolation boxes and transferred to the laboratory of the College of Agriculture, University of Karbala. The fish were stored in the freezer for 14 days. The processes of producing surimi powder from carp fish were carried out once every 2 days with for 14 days (0, 2, 4, 6, 8, 10, 12, 14). This was done by removing the guts and gutting the fish and then washing them with clean, cold water. After peeling and separating the meat from the bones by hand (using a knife), the fish were cut into slices and minced using a meat grinder with a disc containing holes with a diameter of 3 mm. Then the minced meat was washed three times for 12 minutes each time in clean, cold water at 5 °C. After that, the resulting minced meat was used to produce surimi [5]. The following materials were added to the minced meat: (2%) sorbitol, (0.2%) polyphosphate, and (0.25%) table salt. They were all mixed together in a food processor, packed in plastic-sealed containers, and placed in the freezer at -18°C for 24 hours [5]. The production was carried out using the sublimation drying method (lyophilization). For this purpose, the frozen surimi was transferred to the freeze drying device. After 72 hours, the samples reached a constant weight and were removed from the device. The samples obtained after drying were crushed in a laboratory grinder [5]. The chemical composition of surimi fish powder was estimated by measuring the protein content by the Kjeldahl method, the moisture content by drying the samples for 4 h at 105 °C, the fat content by the Soxhlet method, and the ash content by the oven method at 550 °C [4].

Protein solubility in water

The protein of surimi powder was measured by the Kejldal method, and the protein solubility was obtained from [11].

Oil absorption capacity

0.5 g of surimi powder was placed in 50 ml centrifuge tubes and 10 ml of palm oil was added to each tube [2], the samples were kept at (25 °C) for 30 min and stirred for 30 seconds every 10 min [15], then centrifuged for 25 min at 2500 rpm, and finally the remaining amount of oil was poured and weighed, and the oil absorption capacity is expressed by calculating the number obtained in the form of milliliters of oil released per 1 gram of expressed protein [12].

Emulsifying ability

2g of surimi fish powder was mixed with 25ml of distilled water and 25ml of palm oil for 1 minute, and this mixture was placed in a special 50ml centrifuge tube at 7500 rpm for 5 minutes [5].

Emulsion Stability Determination

The emulsifying capacity measurement method mentioned above was used to measure the emulsion stability, with the difference that the emulsion was centrifuged at 90°C for 30 minutes, heated to 100°C and immediately cooled under cold water for 10 minutes [5].

Thiobarbutyric acid value measurement (TBA)

Add (0.3) g of each treatment to a 25 ml glass flask and make up the volume with butanol, stir for 1 minute, then transfer 5 ml of the above solution to dry tubes with caps and add 5 ml of thiobarbital acid reagent (by dissolving 0.2 g of thiobarbital acid powder in 100 ml) and add the butanol solvent with the tube and place the samples for 2 hours in a bath at 95 °C, Then the samples were cooled for 10 minutes, their absorbance was read using a spectrophotometer at a wavelength of 530 nm, and the amount of thiobarbital acid was calculated as milligrams of malondialdehyde in 1000 grams of sample (13).

Gel forming ability

Protein solution was prepared with different concentrations from 1 to 10 g of protein per kg of water and distributed into 10 ml tubes, these tubes were homogenized for one minute and placed in a water bath at 90 °C for 30 minutes and then immediately cooled in a cold water bath (2 °C) and the gel concentration was determined on this basis [14].

Results and Discussion

Table 1 shows that the protein content of surimi powder significantly decreased with freezing duration, from 87.43% on day 0 to 85.11% on day 14. The decrease is attributed to muscle structure degradation and increased autolysis. Moisture content also declined significantly, while fat and ash content increased over the freezing period [15 ,16].

Table (1): Chemical composition of frozen carp surimi powder at -18°C for 14 days

days	Lipids%	Ash%	Moisture%	Protein%
0	^{b}2.75	^{b}2.54	3.53^{a}	87.43^{a}
2	^{b}3.07	^{b}2.62	3.23^{a}	87.12^{a}
4	^{b}3.38	^{b}2.71	3.09^{a}	^{ab}86.87
6	^{ab}3.71	^{b}2.87	^{b}2.85	^{ab}86.54
8	^{b}3.99^{a}	3.04^{a}	^{b}2.66	^{ab}86.08
10	4.19^{a}	3.18^{a}	^{b}2.58	^{b}85.76
12	4.37^{a}	^{ab}3,35	^{b}2.40	^{b}85.47
14	4.55^{a}	^{ab}3.51	^{b}2.25	^{b}85.11

Means with a different small letter in the same column are significantly different (P<0.05)
Means with a different capital letter in the same row are significantly different (P<0.05)

Changes in functional properties of carp surimi powder frozen at -18°C for 14 days.

Table 2 illustrates that oil absorption capacity decreased over time due to increased density. Emulsifying ability and emulsion stability declined with freezing, likely due to protein solubility reduction. Gel-forming ability also decreased, influenced by changes in myosin properties [18,19].

Table (2): Changes in functional properties of carp surimi powder frozen at -18°C for 14 days

The days	% solubility in water	% emulsion stability	% Emulsion capacity	Density g/ml	oil absorption capacity ml/g
0	8.33^{a}	65.43^{a}	56.22^{a}	2.52^{c}	5.51^{a}
2	8.02^{a}	64.55^{a}	55.08^{a}	2.61^{c}	5.30^{a}
4	^{b}7.81^{a}	63.65^{a}	^{ab}53.9	^{b}2.72	5.09^{a}
6	^{b}7.53	^{ab}62.61	^{ab}52.75	^{b}2.79	^{aab}4.90
8	^{b}7.22	^{ab}61.57	^{ab}51.35	^{ab}2.88	^{ab}4.71
10	^{b}6.88	^{ab}60.66	^{b}50.05	^{ab}2.98	^{b}4.52
12	6.45^{c}	^{ab}60.03	^{b}49.77	3.02^{a}	^{b}4.42
14	6.09^{c}	^{b}59.88	48.09^{c}	3.07^{a}	^{b}4.25

Means with a different small letter in the same column are significantly different (P<0.05)
Means with a different capital letter in the same row are significantly different (P<0.05)

Effect of freezing Surimi samples on thiobarbutyric acid values

Table 3. shows us the examination of the amount of thiobarbituric acid by studying the amount of malondialdehyde. According to the table, the amount of thiobarbituric acid in surimi fish powder increased significantly during the period of storing carp fish in the freezer. On the last day of freezing, the amount of thiobarbituric acid showed a significant decrease, which is due to the decomposition of aldehyde and its

decomposition into other substances (ketones and aldehydes) [20]. Other researchers studied the quality of the muscles of Roholapirohyta fish during freezing storage. The amount of thiobarbituric acid in the muscles of the fish had an increasing trend [21]. A study was conducted on mackerel surimi fish and the results showed that the amount of thiobarbituric acid stored in ice increased significantly until the tenth day of storage [22].

Table (3): Thiobarbital acid value of carp surimi powder frozen at -18°C for 14 days

Material	Days							
Thiobarbital acid (mg of malondialdehyde per kg of sample)	0	2	4	6	8	10	21	14
	0.147	0.151	0.158	0.163	0.170	0.179	0.188	0.195

Effect of frozen storage period of carp on gel-forming ability of surimi powder

Table 4. showed that at zero time with a concentration of 2-4%, a weak gel was formed, and at a concentration of 5% and higher, a good gel was formed, indicating a decrease in the ability to form a gel of surimi powder. With the passage of freezing storage time, the nature of fish protein is changed and the ability to form a gel of surimi powder decreases. Some researchers believe that the solubility of protein, which is one of the beneficial features of surimi fish powder, has an effect on the ability to form a gel [23,24] . The solubility of protein decreased with the increase in freezing time of carp fish, as well as the decrease in the ability to form a gel [25-27].

Table (4) : Gel-forming ability of carp surimi powder frozen at -18°C for 14 days

Protein concentration per kilogram of water	Days							
	0	2	4	6	8	10	12	14
1gm	-	-	-	-	-	-	-	-
2gm	±	±	-	-	-	-		-
3gm	±	±	±	-	-	±		-
4gm	±	±	±	±	-	-		-
5gm	±	±	±	±	±	-		-
6gm	+	+	+	±	±	±	±	-
7gm	+	+	+	+	+	±	±	-
8gm	+	+	+	+	+	+	±	±
9gm	+	+	+	+	+	+	+	±
10gm	+	+	+	+	+	+	+	+

+ sign means gel formation, ± sign means gel formation but weak, - sign means no gel formation

The study concludes that freezing carp for more than five days significantly reduces the quality of the resulting surimi powder. While freezing is an effective preservation method, long-term storage negatively affects protein solubility, oil absorption,

emulsification, and gel-forming properties. Short-term freezing (up to five days) is recommended for maintaining high-quality surimi powder.

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