Packaging of Poultry Carcasses with Fortified Collagen Proteins and Its Effect on The Physical Characteristics of Meat Stored for Different Storage Periods

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Abstract

This study was conducted at the Department of Animal Production, Faculty of Agriculture, University of Basra, Iraq. During the period started from 19/12/2021 to 10/5/2022, which aimed to prepare collagen proteins fortified with lysozyme protein and cinnamon oil at the laboratory in the packaging of broiler carcasses (chest) by immersion method and study their microbial qualities when stored by freezing collagen extracted according to the method of Mohd *et al*., (2012). 60 breast fresh pieces of broilers were obtained from local markets in Basra. These pieces were divided into four groups for each treatment with three replicates, and each replicate consists of 5 pieces, these pieces were immersed in the prepared collagen proteins and according to the following: T0 (Treatment of control coated with polyethylene bags only), T1 (breast pieces were coated with collagen only), T2 (breast were coated with collagen enriched with cinnamon oil) and T3 (breast pieces were coated with collagen fortified with the enzyme lysozyme). The treatments were stored by freezing at a temperature of 18 ℃ for (0, 15, 30, 45) days. The physical properties i.e., pH and the percentage of fluid lost during storage and the percentage of liquids lost during cooking were studied. The results showed a high pH and a decrease in the percentage of fluid lost during storage and liquids lost during cooking in the third and fourth treatments compared to the control with the progress of storage periods.

Key words: Poultry carcasses, Physical Properties, Storage periods.

Introduction:

The packaging is an important part of the food processing for the purpose of facilitating the transportation and sale of food products comfortably and maintaining their qualitative characteristics. plastics represents 70 percent of the total packaging materials used in the packaging of food products and that most plastics are not biodegradable and derived from non-renewable materials and that the durability characteristic of them made them useful but their presence in the environment has become continuous and the difficulty of disposing of their waste, which is released annually and at the rate of thousands of tons of major problems that threaten the environment due to pollution caused by it due to

its not decomposition easily as well as some of these substances have a negative impact on human health (Ahmadreza *et al.*, 2021).

Many modern trends have emerged in packaging systems, namely the use of effective packaging and means a packaging system that has characteristics that go beyond the reservation functions of moisture, gases, dissolved substances and others by introducing effective ingredients or materials within the packaging system and to maintain the quality of the product and increase its shelf life (AL-Hilphy *et al.*, 2022**).** It also includes the displacement or expulsion of oxygen or carbon dioxide scavenging oxygen and scavenging carbon dioxide and as a moisture control agent and packaging antimicrobial technologies (Khalaf *et al.*, 2019). The recycling and reuse of waste in some industries has become a feature of progress in many countries of the world to protect the environment, and collagen proteins, which are the result of the waste of poultry slaughterhouses, especially their legs, have received wide attention as they have been used as one of the components of functional food and are considered one of the modern trends in the field of product manufacturing, not their uses for the production of new polymeric materials that are edible and biodegradable for their great ability to react and form clots and gels. Interest in collagen proteins has increased due to their health and environmental benefits and their availability in large quantities as waste, in addition to their non-toxicity, cheapness, high nutritional value and suitability in packaging and protecting the product from damage, (Aydın and omer, 2021). The study aims to:

1. Preparation of collagen proteins at the laboratory and using them in the preparation of membranes in different concentrations and study of their effect on the physical properties.
2. The use of membrane-forming solutions collagen proteins fortified with lysozyme protein and cinnamon oil in the encapsulation of broiler carcasses by immersion method to maintain their quality and study their physical properties when stored by freezing.

Materials and methods:

This study was conducted at the Department of Animal Production, Faculty of Agriculture, University of Basra, Iraq, during the period started from 19/12/ 2021 to 10/5/2022, which aims to prepare collagen proteins fortified with lysozyme protein and cinnamon oil at the laboratory and use them in different concentrations in the packaging of broiler carcasses by immersion method and study their microbial qualities when stored by freezing.

Extract collagen from chicken legs:

Gelatin is extracted according to the method of Mohd *et al*., (2012) from the legs of the chicken after washing the legs well with water and then the legs are cut by a sharp knife after which the skin is removed from the bone and then boiling the legs with water for an hour at a temperature of 80 ° C to get rid of the fat and then filter the extract from the water after which it is treated with sodium hydroxide at a concentration of 0.2% for 60 minutes in the refrigerator and then filter and wash the rest well with water, then soak the extract with acetic acid at a concentration of 0.05% for 18 hours, the acidic solution is disposed of and washed with water and add sodium hydroxide until the confirmation of PH=11 and put it in a water bath at a temperature of 90 ° C for 6 hours and then filter and put in autoclave for an hour and when cooled, the layer of fat is removed and then dried in the regular oven at a temperature of 55 ° C.

Chickens used in the experiment: 60 fresh pieces of breast broilers obtained from local markets in Basra. These pieces were divided into four laboratories for each treatment, with three replicates and

each replicate consists of 5 pieces of the breast; these pieces were immersed in the prepared collagen proteins and according to the following:

1- Treatment of control coated polyethylene bags only (To).
2- The second treatment of breast cuts coated with collagen only (T1).
3- Third treatment chest cuts coated with collagen enriched with cinnamon oil (T2).
4- The fourth treatment of breast cuttings coated with collagen fortified with the enzyme lysozyme (T3).

The treatments were stored by freezing at a temperature of -18℃ for a period of (0, 15, 30, 45) days and the physical properties were studied (pH, percentage of fluid lost during storage and the percentage of fluid lost during cooking).

Physical Properties Measurements:

1 - pH:

The method of John *et al.,* (1975) was followed using a pH meter. 5 g of meat were mixed, and then 10 ml of distilled water (PH = 7) was added in Baker and then left for 5 minutes and then the pH were measured.

2 - Percentage of fluid lost during storage, Loss Drip (DL):

The meat sample (breast, groin) was weighed and then tied by a thin thread made of cotton and placed in small nylon bags and hung in the refrigerator for 48 hours at a temperature of 4° C after which the sample is weighed after being dried by filter paper.

$$\mathrm{DL} = \frac{\text{Original Sample Weighed} \quad - \text{Sample Weighed after48 h}}{\text{Original Sample Weighed}} \text{thread} \times 100$$

3 - Percentage of fluid lost during cooking, Cook Loss (CL):

Rasmussen and Mast, (1989) method was followed in his calculation by grilling the samples in an oven at a temperature of 200° C for 15 minutes and calculated according to the following equation:

$$\mathrm{CL} = \frac{\text{Original Sample Weighed} \quad - \text{Sample Weighed after Cooking}}{\text{Original Sample Weighed}} \times 100$$

Results and discussion:

Effect of broiler meat immersion with fortified collagen proteins and freezing storage periods on some physical qualities:

1 - (pH):

Results in Table (1) shows the effect of cutting breast packaging of chicken carcasses with collagen proteins fortified on pH and stored by freezing for different storage periods where the results showed significant differences between treatments zero and after 15 days of storage, and the treatments T2 and T3 showed a significant superiority ($P \leq 0.05$) (6.13, 6.16) and (6.36, 6.36) over the two treatments T0 and T1 (6.06, 6.04) and (6.36, 6.36) respectively. At the time of storage 30 days, no significant differences were shown between treatments. The storage period of 45 days, the treatments (T1, T2 and T3) showed a significant superiority ($P \leq 0.05$) (6.33, 6.41 , 6.44) respectively over the control T0 (6.26) . It is noticed from the Table (3) the increase in pH values with the progress of storage periods by freezing and for all treatments and this is due to the collagen protein, that contributes to the retention of fluid amounts inside the muscles and thus leads to an increase in pH, these results were consistent with Yang *et al*., (2014) who demonstrated that pH values of all samples gradually increased until they reached their maximum value at the end of the storage period. It has been seen a rise in pH at storage

periods of 30 and 45 days, which increased the amount of fluid associated with meat and a decrease in the amount of fluid lost due to meet retention of water (Yang *et al*., 2014).

Table: 1 Effect of Cutting Chest Packaging of Chicken Carcasses with Collagen Proteins Fortified in pH Frozen Stored for Different Storage Periods 0 (Average ± Standard Error)

Storage Periods/Day				Treatments
45	**30**	**15**	**Zero**	
6.26^{b}± 0.03	6.26 ± 0.03	6.16^{b} ± 0.03	6.06^{b} ± 0.03	**T0**
6.33^{a} ± 0.06	6.36 ± 0.03	6.06^{b}± 0.02	6.04^{b} ± 0.03	**T1**
6.41^{a} ±0.08	6.43 ± 0.03	6.36^{a} ± 0.04	6.13^{a} ± 0.08	**T2**
6.44^{a} ±0.03	6.40 ± 0.05	6.36^{a} ± 0.05	6.16^{a} ± 0.03	**T3**
**	N.S	**	**	**Significance**

N.S: no significant differences, (**): significant differences between treatments at the level of probability of 0.05. (T0): Control treatment, (T1): Collagen protein encapsulation treatment, (T2): Collagen protein enrichment with cinnamon oil, (T3): Collagen protein encapsulated with enzyme lysozyme.

2 - Percentage of fluid lost during storage:

Results in Table (2) show the effect of encapsulation of chicken carcasses with fortified collagen proteins on the percentage of fluid lost during storage stored by freezing for different storage periods, where the results showed significant differences between the treatments at the storage period of zero while the two treatments T0 and T1 showed a significant superiority (P≤0.05) (9.25, 8.76) respectively over the two treatments T2 and T3 (6. 68, 6. 00) respectively. As for the storage period of only 15 days, the two treatments T0 and T1 exceeded (P≤0.05) (7. 34, 7. 29) respectively, the two treatments T2 and T3 (6.38, 6.65) respectively. As for the storage period of 30 days, the treatment T0 significantly (P≤0.05) exceeded the treatments T2 and T1 and the two treatments showed a significant superiority (P≤0.05) over the treatment T3 where the values reached (6.45, 6.08, 5.52 and 4.83) respectively. While the storage period of 45 days the treatment T0 significantly (P≤0.05) (5.94) exceeded the treatments T1 and T3 (5.07, 4.26) respectively, and the two treatments showed a significant superiority (P≤0.05) over the treatment T2 (3.85). Table (2) shows the effect of storage on the percentage of liquids lost during freezing storage on meat of broiler breasts, the results showed significant differences in the fluids lost at the laboratories with fortified collagen proteins and cinnamon oil gave the lowest percentage of loss (3.85) at a storage period of 45 days compared to the control treatment which gave the highest value (9.25) at zero-day storage period.

These results are consistent with Abdalhai *et al*., (2014), where a decrease in the percentage of fluid lost is observed with the progress of the storage period, and the reason is that gluten helped in reducing the amount of fluid lost because gelatin acts as a barrier to water loss (Krochta and Johnson 1997).

Table 2. Effect of packaging breast of chicken carcasses with fortified collagen proteins and their effect on the percentage of liquids lost during storage by freezing for different storage periods (average ± standard error)

Storage Periods/Day				Treatments
45	30	15	zero	
5.94^{a} ± 0.47	6.45^{a} ± 0.27	7.34^{a} ± 0.13	9.25^{a} ± 0.26	**T0**
5.07 ^{b} ± 0.68	6.08^{b}± 0.31	7.29^{a} ± 0.10	8.76^{a} ± 0.15	**T1**
3.85^{c} ± 0.69	5.52^{b}± 0.22	6.38^{b} ± 0.14	6.68 ^{b}± 0.27	**T2**
4.26 ^{b} ± 1.00	4.83^{c} ± 0.18	6.65^{b} ± 0.22	6.00^{c} ± 0.05	**T3**
*	**	**	**	**Significance**

N.S: no significant differences, (**): significant differences between treatments at the level of probability of 0.05. (T0): Control treatment, (T1): Collagen protein encapsulation treatment, (T2): Collagen protein enrichment with cinnamon oil, (T3): Collagen protein encapsulated with enzyme lysozyme.

3 - The percentage of fluid lost during cooking:

Results of Table (3) show the effect of encapsulation breast chicken carcasses with fortified collagen proteins on the percentage of liquids lost during cooking stored by freezing for different storage periods. As the results showed significant differences between the treatments at the storage period of zero where the treatment T0 significantly (P ≤0.05) exceeded the two treatments T1 and T2 where the values reached (26.62, 25.53 and 24.53) respectively. The two treatments showed a significant superiority (P≤0.05) over T3 treatment which amounted to (22.60). As for the storage period of only 15 days, the two treatments, T0 and T1 showed a significant superiority (P≤0.05) over the two treatments T3 and T2 that reached (22.00 and 21.22) respectively. While T2 and T3 reached (18. 02 and 16.90) respectively. As for the storage period of 30 days, T0 treatment showed a significant superiority (P≤0.05) over the treatments T1, T2 and T3 that valued (21.63, 19.79, 18.76 and 17.64) respectively. While the storage period of 45 days, treatments T0 and T1 showed a significant superiority (P≤0.05) over T2 treatment, which significantly (P≤0.05) outperformed over T3 treatment with values of (23.10, 22.03, 20.26, and 17.27) respectively.

Table 3. Effect of breast packaging of chicken carcasses with fortified collagen proteins and its effect on the percentage of liquids lost during cooking stored by freezing for different storage periods (average ± standard error)

Storage Periods/Day				Treatments
45	30	15	zero	
23.10^{a} ± 1.66	21.63^{a} ± 1.24	22.00^{a} ± 0.66	26.62^{a} ± 0.37	**T0**
22.03^{a} ± 1.67	19.79^{b} ± 0.93	21.22^{a} ± 0.96	25.53^{b}± 0.17	**T1**
20.26^{b} ± 0.39	18.76^{b} ± 0.66	18.02^{b}± 0.98	24.53^{b}± 0.41	**T2**
17.27^{c} ± 1.10	17.64^{b} ± 0.12	16.90^{b}± 0.98	22.60^{c} ± 0.52	**T3**
**	*	**	**	**Significance**

N.S: no significant differences, (**): significant differences between treatments at the level of probability of 0.05. (T0): Control treatment, (T1): Collagen protein encapsulation treatment, (T2): Collagen protein enrichment with cinnamon oil, (T3): Collagen protein encapsulated with enzyme lysozyme.

At 45 days of storage period, collagen-coated treatments fortified with cinnamon oil and lysozyme protein were less in the percentage of fluid lost when cooking, and these results agreed with Moorjani *et al*., (1978) who noticed that pieces of broilers coated with gelatin were more fluid-retaining when cooked. The use of gelatin in the packaging of fried foods reduced the percentage of moisture lost and gave the product the highest juice compared to the rest of the other factors, due to the composition of the protein substance in it, which has a great ability to react and form clots and gels and has a high viscosity (Greusot *et al*., 2011; Weber, 2000).

Conclusions:

The results showed that the use of collagen encapsulated with cinnamon oil and lysozyme protein improved the physical properties of frozen breast meat and prolonged its storage life**.**

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