**Journal of Food Science and Technology (Iran)**

**Homepage:**www.fsct.modares.ir

**Scientific Research**

# Evaluation of edible coating based on chicken foot gelatin / green walnut skin extract on physical characteristics, color and texture characteristics of rainbow salmon fillet during storage in refrigerator.

Nasreen Afshar[1], Seyed Hossein Seyed Qavami[2], Naser Sadaqat[*3]

1- Master student of Food Science and Industry, Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad, Iran.

2- Master student of Food Science and Industry, Faculty of Basic Sciences, Islamic Azad University, Lahijan Branch, Iran.

3- Professor, Department of Food and Aquatic Health, Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad, Iran

## ABSTRACT

Considering the high perishability, quality reduction, and nutritional value of the fish during the storage period, the aim study is to investigate the edible coating based on chicken feet gelatin/green walnut skin extract to preserve the physical characteristics, color, and texture properties of *Oncorhynchus mykiss* fillet during storage in the refrigerator. After extracting gelatin and green walnut skin extract, the coating solution were prepared. The fillets were coated by immersion method. Physical characteristics (moisture), color indices (L*, a*, and b*) as well as textural properties (hardness, springiness, and Cohesiveness) of the fillets were evaluated during 12 days of storage (on days 0, 4, 8, and 12). Variance analysis was performed by Minitab software (version 18). The mean data comparison by Tukey's test is at a 95% confidence level. The results showed significant moisture retention of coated fillets ($p<0.05$). The L* and a* index of fillets decreased during 12 days of storage. While, the b* index was increased in all samples ($p<0.05$). The evaluation of the texture of the fillets showed a decrease in hardness and Cohesiveness, but springiness was increased ($p<0.05$). The coat had significantly higher hardness, Cohesiveness, and lower springiness than the control sample ($p<0.05$). Increasing the concentration of green walnut skin extract from 500 to 1000 ppm increased the quality of fillets ($p<0.05$). In general, It can be concluded that edible coating based on chicken leg gelatin/green walnut skin extract effective to increase shelf- life aquaculture industry.

## ARTICLE INFO

**Article History:**

Received: 2023/3/31
Accepted: 2023/6/13

**Keywords:**

edible coating,

chicken foot gelatin,

green walnut skin extract,

fish,

preservation

**DOI: 10.22034/FSCT.20.142.1**
**DOR:20.1001.1.20088787.1402.20.142.1.1**

*Corresponding Author E-Mail:
sedaghat@um.ac.ir

## 1. Introduction

Rainbow trout*(Oncorhynchus mykiss)* It is one of the most important species of freshwater fish to increase its global trade. Nevertheless, salmon is very susceptible to oxidative degradation due to the high proportion of saturated and unsaturated fatty acids (23.5%), high protein content (20%) and low stability related to hemoglobin composition and structure [1]. Oxidative degradation is the main cause of non-microbial, unpleasant taste, color change, loss of texture and formation of toxic compounds in the period after the death of fish, which are among the factors of shorter shelf life, rapid decrease in quality and non-acceptance by consumers [2]. Nowadays, the applications of active edible and environmentally friendly packaging have been studied due to the great interest of consumers in healthy, safe and natural food and the attention of researchers to meet the needs of consumers and producers and as an alternative to traditional/synthetic packaging [3]. [. Among the biodegradable compounds, protein and polysaccharides are the most stable and renewable biopolymers for food packaging applications. Gelatin is one of the important components of protein packaging, which has recently gained importance due to its nutritional value and film-forming ability. Gelatin can be obtained through partial hydrolysis of collagen from certain mammals such as pork, beef or chicken [3, 4]. Poultry processing industries produce various by-products such as feathers, internal organs and chicken legs. Chicken feet is one of the dominant poultry by-products, and 3.9 million tons of chicken feet are produced worldwide annually by poultry processing industries. Chicken feet are rich in collagen; The use of chicken feet as a raw material for extracting gelatin will not only benefit the poultry industry, but will also lead to the production of a relatively cheap and accepted alternative to mammalian gelatin [5]. Considering the importance of microbial growth in reducing the quality of meat, fish and derived products, adding or increasing the antimicrobial activity of films and coatings is an interesting strategy to improve the shelf life of these foods. Essential oils, plant extracts, spices, fruits, etc. provide a wide range of these compounds [6]. Studies on the use of plant extracts in polymer matrix as biodegradable active packaging to increase the quality and shelf life of food are presented. Healthy[1] et al. (2021) to investigate the physical and functional properties of dogfish skin gelatin-based films enriched with seed extracts*Identification tag*they paid. The researchers showed that the prepared films had high antioxidant and antibacterial potential. Also, the integration of the extract caused a decrease in the brightness index and an increase in its redness and yellowness index [7]. Also Tkachuska[2] et al. (2022) prepared an edible coating based on carp skin gelatin enriched with rosemary extract. They showed that added rosemary coatings were effective in inhibiting the formation of biogenic amines and reducing the rate of microbial deterioration of carp fillets. The evaluated vegetation changed the characteristic taste of the fish [8]. walnut*(Juglans regia L.)* It is mainly cultivated as nuts or to use its wood. The green shell is the outer shell (mesocarp) of the walnut fruit and it makes up an average of 55% of the walnut tree, which often represents industrial waste that is difficult to dispose of. However, during the past years,

[1] -Salem

[2] -Tkaczewska

the green skin of walnut has been recognized as a potential source of phenolic compounds and bioactive compounds [9]. Phenolic acids, juglone[3], tocopherols and flavonoids are the most abundant phenolic compounds in green skin of walnut with antioxidant and antibacterial properties [10]. Therefore, the green shell of the walnut is a natural source of active compounds (polyphenols) and is ideal for their extraction. Paying attention to the fact that so far no research has been done regarding the use of strong antioxidant and antimicrobial effects of walnut extract in the preservation of meat tissues, this study investigates the production of edible coating based on gelatin. **Leg**Chicken (in concentrations of 2.5 and 5 percent)/ Green walnut skin extract (in concentrations of 100, 500 and 1000ppm) the simultaneous combination was compared with the control sample on the color and textural properties of rainbow trout during storage in the refrigerator.

## 2- Materials and methods

### 1-2- Preparation of raw materials

### 1-1-2-extraction of walnut green skin extract

The green shells of walnuts were collected from walnut orchards located in Targaba, Mashhad. After washing and rinsing, they were dried in a dark environment without light and at room temperature. Dried shells with a laboratory mill (PX-MFC90D, Switzerland) were powdered. the operationIsKharaj with methanol solvent (for every 30 grams of walnut shell powder, 400 milliliters of solvent) with a Soxhlet apparatus.Gerhardt, Germany) to It was done for 48 hours at a temperature of 65 degrees Celsius. After the extraction process is over, an extract obtained with a rotary machine (Heidolf, Germany) was concentrated for 10 minutes and transferred into the plates. Methanol solvent in a vacuum oven (Binder, Germany) was separated from the extracts [11].

### 2-1-2-extraction of chicken feet gelatin

Chicken feet (contains 0.01± 60.53 percent humidity, 0.05± 17.18% protein, 0.03± 2.75% fat, 0.07± 0.26 percent of ash and 0.06± 18.29 percent of carbohydrates) were purchased from Tiuran Company located in Mashhad and transported to the laboratory under cold conditions. After washing and separating the nails, they were chopped into 0.5 cm pieces. In order to remove non-collagenous materials, the crushed pieces are first in a solution of 0.1% sodium hydroxide (Merck- Germany) were soaked for 40 minutes. After draining the alkaline solution, the remaining parts were washed three times with distilled water. Then the samples were soaked in acetic acid solution for 40 minutes.Merck- Germany) soaked in 0.1% and after removing the acid solution and washing,pH The material was neutralized. Finally, gelatin was extracted from chicken feet with distilled water (1:9 ratio) for 90 minutes at 70 degrees Celsius. After passing through the sieve, the remaining materials were dried and milled using a freeze dryer (Pishtaz Equipments - Iran). Finally, gelatin powder was obtained [12].

### 3-1-2- Preparation of fish

Rainbow salmon with an average weight of 500 to 600 grams was purchased from a fish farm located in Kalt city of Mashhad and transported to the laboratory under cold conditions. After washing and cleaning (including emptying the intestines and viscera, tailing and decapsulating, skinning, etc.), the fillets were prepared by hand weighing 100 grams [13]. The obtained fillets contain 0.23± 75.38 percent humidity, 0.38± 17.25% protein, 0.35%± 5.50 percent of fat and 0.14± 1.87% were ash.

### 4-1-2-preparation of barbed coverings and fish coverings

[3]- juglone

First, gelatin powder was transferred into the human body at two levels of 2.5 and 5% (weight-by-weight) and walnut extract powder at three levels of 100 and 500.ppm were added to the contents of human beings. Glycerol (Merck- Germany) as a plasticizer was added to the previous compositions and finally the total volume was brought to 100 milliliters with distilled water, then a magnet was placed inside each beaker and the lid of the beaker was covered with foil and using a magnetic stirrer (Gerhardt- Germany) the homogenization of the solution was done for 30 minutes. In order to cover, the fillets were immersed in the prepared solutions (according to Table 1) for 1 minute. Then they were taken out of the solution and after the check water was finished, the fillets were placed under a gentle flow of air to dry. The fillets were left for 5 hours at 10 degrees Celsius at room temperature until the coating was formed on the fillets. After drying the coating, the fillets were transferred to the refrigerator and kept at a temperature of 4 degrees Celsius for 12 days [14]. The tests were performed in 4-day intervals.

## 2-2- Tests

### 2-2-1- Humidity test

Determining moisture content based on drying fish fillets in an oven at 130 degrees Celsius according to the standard methodAOAC [15] was done.

### 2-2-2- Color test

Colorimetry with colorimeter model 0/45 (Color flex- America) was done. After the initial photography of the valuesL* ، a* Andb*which represent brightness, redness and yellowness, respectively, were measured with the Huntlab device and the color of the fillets was compared with the control sample [16].

### 2-2-3- Texture test

For this purpose, fish fillet slices were prepared in dimensions of 30 x 30 mm with a thickness of 12 mm. Textural indicators (hardness, elasticity, cohesion and chewability) with a texture measuring device.Ametek-America) modelCT3 Equipped with 8/50 cylinder probeTA25/1000*done [16].

## 3-2- Statistical Analysis

The tests were conducted in a completely randomized design with 7 treatments and 4 times (1, 4, 8 and 12 days) in three replications. Data analysis was done using the analysis of variance by Minitab software (version 18). Comparison of mean data was done by Tukey's test at 95% confidence level.

**Table1. Research treatments**

| Treatment | Formulation |
|---|---|
| GE1-H1 | 100 ppm green walnut skin extract + 5% chicken leg gelatin |
| GE1-H2 | 1000 ppm green walnut skin extract + 5% chicken leg gelatin |
| GE2-H1 | 100 ppm green walnut skin extract + 2.5% chicken leg gelatin |
| GE2-H2 | 1000 ppm green walnut skin extract + 2.5% chicken leg gelatin |
| Co | Control |
| GE1-H3 | 500 ppm green walnut skin extract + 5% chicken leg gelatin |
| GE2-H3 | 500 ppm green walnut skin extract + 2.5% chicken leg gelatin |

## 3. Results and Discussion

### 1-3- Humidity measurement

A decrease in humidity causes a decrease in weight, an increase in oxidation changes, changes in the nature of protein, changes in color, and as a result, a decrease in the quality of the product [17]. According to the studies, the physical property and permeability of the coating is affected by the ratio of materials used in it [18]. Due to its surface activity, gelatin can act as an obstacle to the movement of water molecules and reduce their diffusion rate [19]. In general, many factors affect the water storage capacity, which can bepH , salts, microorganisms, meat compounds, etc. After the slaughter until the beginning of the dead body, the meat haspH It is about 5, which has the highest water retention and absorption capacity. During the shelf life with a decreasep H The water holding capacity also decreases and after 24 to 48 hours it will reach its lowest level (about 4.5 to 5.5). During the stages of crispness and ripening, the water retention capacity of the muscle gradually increases, but it will never reach the initial level, that is, before the onset of cadaveric stasis. However, all the factors thatpH They affect the water storage capacity [19]. According to the results presented in Table 2, on day zero, there was no significant statistical difference between the moisture content of the samples($p>0.05$). With the passage of storage time, the percentage of significant difference in the content between the coated samples and the control sample(Co) was observed($p<0.05$). The samples coated with chicken leg gelatin and green walnut skin extract had the highest moisture content compared to the control sample.($p<0.05$). The use of gelatin alone as a coating alone did not show a significant difference with the control treatment on different days of the experiment; If the fillets are coated, especially with coatingGE1-H2 They showed the highest amount of moisture at the end of storage time($p<0.05$). At the beginning of the period, the moisture content of the fillets coated with this treatment was equal to 76.0%, and at the end of the period, with the least amount of moisture loss, the highest moisture content (0.14)± 72/34). The use of edible coatings seems to be an interesting alternative to increase the shelf life of freshly cut foods, reduce microbial contamination, create resistance to gas exchange, and delay moisture loss. The reason for the decrease in humidity in the coated samples is probably due to the decrease in permeability and the increase in the antioxidant properties of the coatings [20]. In this regard, Rodriguez[4] et al. (2018) showed the use of flax seed mucilage as a coating for yakon fish fillet *(Smallanthus sonchifolius)* showed a decrease in the moisture content of the treatments [21]. Place Vital[5] et al. (2021) during the study of the effect of active food coating and essential oils on the oxidation of sheep meat during 10 days of storage in modified atmosphere packaging, reported a decrease in the moisture loss of the meat in the coated treatments [22].

[4]- Rodrigues

[5]- Pelaes Vital

**Table2. The effect of chicken feet gelatin and green walnut husk on the moisture (%) of rainbow trout fillets over storage time at refrigerator temperature (5.0±1.0 °C)**

| Treatment | 1 day | 4 day | 8 day | 12 day |
|---|---|---|---|---|
| GE1-H1 | $75.06 \pm 0.51^{And}$ | $74.69 \pm 0.18^{ABde}$ | $72.55 \pm 0.11^{Cdef}$ | $70.98 \pm 0.05^{Dfg}$ |
| GE1-H2 | $76.72 \pm 0.77^{Aa}$ | $75.50 \pm 0.13^{ABabcd}$ | $74.09 \pm 0.06^{Cabc}$ | $72.87 \pm 0.15^{CDabcd}$ |
| GE2-H1 | $76.57 \pm 0.30^{Aa}$ | $75.72 \pm 0.21^{ABabcd}$ | $72.18 \pm 0.09^{Cef}$ | $70.85 \pm 0.05^{CDfg}$ |
| GE2-H2 | $76.45 \pm 1.50^{Oops}$ | $75.90 \pm 0.11^{ABabcd}$ | $73.89 \pm 0.01^{Cbcd}$ | $72.34 \pm 0.14^{Dcde}$ |
| Co | $75.96 \pm 1.86^{Aa}$ | $74.19 \pm 0.23^{ABe}$ | $71.43 \pm 0.22^{Cefg}$ | $69.83 \pm 0.04^{Eg}$ |
| GE1-H3 | $76.11 \pm 1.41^{Aabc}$ | $75.37 \pm 0.02^{Babcde}$ | $73.28 \pm 0.02^{Ccde}$ | $71.66 \pm 0.05^{Def}$ |
| GE2-H3 | $76.30 \pm 1.35^{Abc}$ | $75.13 \pm 0.13^{Babcde}$ | $73.05 \pm 0.05^{Ccde}$ | $71.39 \pm 0.09^{Def}$ |

(GE1-H1: Coating containing 100 ppm green walnut husk and 5% Chicken feet gelatin, GE1-H2: Coating containing 1000 ppm green walnut husk and 5% Chicken feet gelatin, GE2-H1: Coating containing 100 ppm green walnut husk and 2.5% Chicken feet gelatin, GE2-H2: Coating containing 1000 ppm green walnut husk and 2.5% Chicken feet gelatin, Co : Control sample, GE1-H3: Coating containing 500 ppm green walnut husk and 5% Chicken feet gelatin, GE2-H3: Coating containing 500 ppm green walnut husk and 2.5% Chicken feet gelatin)

The different small or capital letters indicate significant difference at the level of 5% ($P < 0.05$)

## 2-3-Evaluation of color

The color of food is one of the quality parameters that consumers use to accept or reject a food. The color of meat surface is one of the important visual indicators of meat quality. The color of meat is caused by the action of two factors of meat pigments (mainly myoglobin and hemoglobin) and the characteristic of light scattering. The feeling that is given to the viewer by watching the color of meat and meat products through nervous movements is very effective in deciding to buy this food product. For this reason, meat product marketing specialists reported that the names of colors do not correspond to the feelings it creates in people. Therefore, they recommended measuring colors with colorimeters. Today, in order to measure colors from the methods determined by the International Illumination CommissionCIE is used With the above methods, the type of color is related to the wavelength, and also the saturation or brightness of the color is measured, which is related to its purity, that is, a certain wavelength or its combination with other wavelengths. Color featuresCIELAB involved inL* (lightness/darkness),a* (red/green) andb* (yellow/blue) [23].

On the first day of the storage period, coated samples compared to a control sample with valuesL* were higher($p<0.05$). During the storage period of 12 days in the refrigerator, the amountL*All samples decreased($p<0.05$). Fish meat becomes darker during storage due to spoilage, which leads to a decrease in brightness. the amount ofL* The higher coated samples can be due to the effect of gelatin coating, which creates a clear, bright and smooth polymeric layer on the surface of the meat, which leads to more scattering and brightness [24]. The brightness of the meat depends on many factors such aspHIt depends on protein color change, lipid oxidation and microbial spoilage. Samples coated with high concentration of green walnut skin extract and chicken leg gelatin on the last day of the storage period have the highest amountL* They were($p<0.05$) This may be due to the antibacterial and antioxidant property of the coating [25], which has increased the protective properties of the coating with the addition of both substances, i.e. walnut skin extract and chicken leg gelatin.

a* A common index to evaluate the red color and therefore the quality of the meat, like beef, is generally the quantitya* (red) more indicates the freshness of the meat. But in relation to fish meat, quantitya*It depends a lot on its species [25, 26]. On the first day of storage, there was no significant difference between the coated samples and the control sample($p>0.05$). It can be said that the coatings have a direct effect on the amounta*The fish fillet samples did not have any, but with the passage of time during 12 days of storage in the refrigerator, the amounta*All samples decreased gradually($p<0.05$). The red color of the meat has a lot to do with the presence of hemoglobin and myoglobin pigments in the meat, as a result of the decrease in the amounta*During the storage period, it is mainly due to the oxidation of these pigments and the creation of brown met-myoglobin and met-hemoglobin [26]. On the last day of storage of all samples, especially the control sample with the amounta* were low, this indicates the intensity of oxidation and color change in the control sample, but the high valuea*In the coated samples on day 21, it shows that these coatings have a protective effect against color change compared to the control sample. Use coverGE1-H2AndGE2-H2 In addition to preventing moisture and gases, the antioxidant and antibacterial activity obtained from green walnut skin extract showed a significant difference with other samples. The red color during the storage period is attributed to the dependence between the oxidation of lipids and the oxidation of pigments. According to researchers, the oxidation of pigments can speed up the oxidation of lipids, and the free fatty acids produced during the oxidation of lipids cause the oxidation of iron atoms and also denature myoglobin molecules and affect the color of meat products [27, 28]. Linar[6] et al. (2007) reported that there is a relationship between pigment color stability and the development of lipid oxidative processes. Therefore, it shows a high correlation between the accumulation of carbonyl compounds, by the oxidation of polyunsaturated fatty acids, with the process of myoglobin oxidation [29]. Zhang[7] et al. (2016) showed that the use of oregano essential oil increases the shelf life of meat and significantly increases the indexa* and they explained the reason for this because of the reduction of myoglobin oxidation [30].

Amountsb* All the samples gradually increased over time, and the increased yellowness of the fillet samples could be due to the high levels of fat oxidation and the accumulation of methemoglobin and methemoglobin [31]. Studies have shown that fish meat turns yellow over time [18, 32]. In this research, the coated samples compared to the control sample had a significant effect on the amountb* They did not show until the 8th day($p>0.05$) But on the 12th day, the coated samples compared to the control sampleb*They had less($p<0.05$). Therefore, it can be said that the created coating effectively prevents the yellowness of salmon meat. Linaro et al. (2007) showed that the coating of meat with essential oil of thyme and oregano is a parameterb* increased in treatments containing extract [29].

[6]- Buffaloes

[7]- Zhang

**Table2. The effect of chicken feet gelatin and green walnut husk on the color index (L*, a* and b*) of rainbow trout fillets over storage time at refrigerator temperature (5.0±1.0 °C)**

| | Treatment | 1 day | 4 day | 8 day | 12 day |
|---|---|---|---|---|---|
| L* | GE1-H1 | 56.03 ± 0.11$^{Ab}$ | 54.65 ± 0.18$^{Bcd}$ | 53.69 ± 0.06$^{Cbc}$ | 52.04 ± 0.04$^{Dc}$ |
| | GE1-H2 | 57.21 ± 0.23$^{Aa}$ | 55.30 ± 0.13$^{Chapter}$ | 54.59 ± 0.03$^{That}$ | 53.66 ± 0.16$^{And}$ |
| | GE2-H1 | 55.13 ± 0.14$^{Ade}$ | 52.72 ± 0.26$^{Bh}$ | 51.25 ± 0.20$^{This}$ | 50.34 ± 0.18$^{Dd}$ |
| | GE2-H2 | 55.85 ± 0.27$^{Abc}$ | 54.90 ± 0.27$^{Bde}$ | 54.03 ± 0.03$^{BCbc}$ | 53.52 ± 0.18$^{CDa}$ |
| | Co | 54.01 ± 0.39$^{Of}$ | 50.19 ± 0.34$^{Bf}$ | 48.79 ± 0.26$^{Cf}$ | 47.92 ± 0.10$^{Of}$ |
| | GE1-H3 | 55.84 ± 0.12$^{Abc}$ | 53.37 ± 0.93$^{Bef}$ | 53.22 ± 0.05$^{Ccd}$ | 52.83 ± 0.27$^{CDb}$ |
| | GE2-H3 | 55.65 ± 1.35$^{Abcd}$ | 53.13 ± 0.21$^{Bg}$ | 52.89 ± 0.11$^{BCd}$ | 52.26 ± 0.07$^{Dc}$ |
| a* | GE1-H1 | 5.14 ± 0.12$^{Aa}$ | 3.48 ± 0.04$^{Bf}$ | 2.79 ± 0.02$^{Cd}$ | 1.83 ± 0.03$^{Of}$ |
| | GE1-H2 | 4.49 ± 0.22$^{Acd}$ | 4.18 ± 0.02$^{Chapter}$ | 3.88 ± 0.02$^{Cb}$ | 3.05 ± 0.04$^{Db}$ |
| | GE2-H1 | 4.35 ± 0.14$^{Ad}$ | 3.72 ± 0.06$^{Bef}$ | 2.63 ± 0.08$^{Cde}$ | 2.01 ± 0.01$^{Of}$ |
| | GE2-H2 | 4.94 ± 0.06$^{Oops}$ | 4.61 ± 0.10$^{Not}$ | 4.04 ± 0.04$^{Cab}$ | 3.50 ± 0.04$^{And}$ |
| | Co | 4.61 ± 0.03$^{And}$ | 3.07 ± 0.04$^{Bg}$ | 3.07 ± 0.03$^{Cf}$ | 1.29 ± 0.02$^{Df}$ |
| | GE1-H3 | 4.60 ± 0.08$^{And}$ | 3.97 ± 0.06$^{Bcd}$ | 3.09 ± 0.04$^{Cc}$ | 2.44 ± 0.03$^{Dd}$ |
| | GE2-H3 | 4.72 ± 0.07$^{Abc}$ | 3.79 ± 0.03 $^{Bde}$ | 3.16 ± 0.01$^{Cc}$ | 2.63 ± 0.03$^{Dcd}$ |
| b* | GE1-H1 | 15.42 ± 0.07$^{Ad}$ | 16.42 ± 0.03$^{Not}$ | 17.92 ± 0.03$^{That}$ | 1.83 ± 0.03$^{And}$ |
| | GE1-H2 | 15.91 ± 0.05$^{Aa}$ | 15.29 ± 0.02$^{Be}$ | 16.19 ± 0.03$^{This}$ | 3.05 ± 0.04$^{Of}$ |
| | GE2-H1 | 15.55 ± 0.05$^{Abcd}$ | 16.30 ± 0.03$^{Chapter}$ | 17.66 ± 0.03$^{Cb}$ | 2.01 ± 0.01$^{Db}$ |
| | GE2-H2 | 15.68 ± 0.04$^{Ab}$ | 15.15 ± 0.02$^{Bf}$ | 16.05 ± 0.03$^{Cf}$ | 3.50 ± 0.04$^{Df}$ |
| | Co | 15.36 ± 0.04$^{And}$ | 16.80 ± 0.02$^{Bc}$ | 18.66 ± 0.05$^{Cg}$ | 1.29 ± 0.02$^{Dg}$ |
| | GE1-H3 | 15.52 ± 0.08$^{Acd}$ | 16.13 ± 0.03$^{Bc}$ | 17.22 ± 0.03$^{Cc}$ | 2.44 ± 0.03$^{Dc}$ |
| | GE2-H3 | 15.56 ± 0.05$^{Abc}$ | 16.03 ± 0.02 $^{Bcd}$ | 17.05 ± 0.03$^{Cd}$ | 2.63 ± 0.03$^{Dd}$ |

(GE1-H1: Coating containing 100 ppm green walnut husk and 5% Chicken feet gelatin, GE1-H2: Coating containing 1000 ppm green walnut husk and 5% Chicken feet gelatin, GE2-H1: Coating containing 100 ppm green walnut husk and 2.5% Chicken feet gelatin, GE2-H2: Coating containing 1000 ppm green walnut husk and 2.5% Chicken feet gelatin, Co : Control sample, GE1-H3: Coating containing 500 ppm green walnut husk and 5% Chicken feet gelatin, GE2-H3: Coating containing 500 ppm green walnut husk and 2.5% Chicken feet gelatin)

The different small or capital letters indicate significant difference at the level of 5% (P <0.05)

## 3-3- Texture evaluation

The characteristics of fish texture is an important parameter that directly affects the acceptance and acceptability of protein-rich foods by consumers. The hardness of the fish muscle can be mentioned as one of the important tissue indicators. This index depends not only on intrinsic factors (amount and distribution of water, amount and distribution of lipid and collagen), but also on external factors (time and temperature), storage and processing conditions [33, 34]. Among the factors that cause changes in tissue properties, endogenous proteases of muscles and microbial proteolytic enzymes that break collagen connections can be mentioned [35]. In this evaluation, according to Table 3, there was no significant difference in the degree of hardness among the samples on the first day of storage($p>0.05$). But with the passage of time, the severity of all treatments decreased significantly during storage($p<0.05$). But the coated samples showed higher hardness than the control

sample($p<0.05$). Probably, the coated samples inhibited the activity of the endogenous proteases of the muscles due to the antioxidant effect of the coating, and it can also be related to the reduction of the microbial load due to the reduction of the water storage capacity [36]. The coated samples showed a higher degree of hardness than the control sample on the 12th day of storage($p<0.05$). The elastic properties of all samples decreased during the 12-day storage period. Coated samples contain 1000ppm Green walnut skin extract showed more elasticity than other treatments at the end of the period. Coherence, which is considered as a criterion for the decomposition of fillets, decreased significantly during the storage period($p<0.05$). After 12 days of storage in the refrigerator, the coated samples showed more cohesion than the control sample($p<0.05$). Among the fillets covered with treatments containing 1000ppm Walnut green peel extract had the highest amount of cohesion($p<0.05$). The decrease in elasticity and integrity of salmon fillets during storage in the refrigerator is probably due to the destruction of high molecular weight proteins [37]. Merlo et al. (2019) showed that when salmon fillets were coated with kituran and pink pepper extract during 28 days of storage, the lowest hardness reduction was reported in the coated fillets [38]. Yerlikaya[8] and colleagues during the investigation of green tea, grape seed and pomegranate peel extracts to preserve the quality characteristics of bonito fillets*(Sarda sarda)* They showed that a firmer product with less adhesion was obtained with control groups followed by green tea extract fillets [39]. [39]. Kai[9] et al. (2020) also showed that the use of clove, cumin and mint extracts preserves the texture of sperm whale fillets.*(Scophthalmus maximus)*They were kept over time.

[8]- Yerlikaya

[9] - Right

**Table3. The effect of chicken feet gelatin and green walnut husk on Texture of rainbow trout fillets over storage time at refrigerator temperature (5.0±1.0 °C)**

| | Treatment | 1 day | 4 day | 8 day | 12 day |
|---|---|---|---|---|---|
| Hardness (N) | GE1-H1 | 12.20 ± 0.04$^{Ab}$ | 10.63 ± 0.15$^{Bc}$ | 8.75 ± 0.12$^{Cc}$ | 7.80 ± 0.05$^{Dd}$ |
| | GE1-H2 | 12.28 ± 0.04$^{Aa}$ | 11.81 ± 0.07$^{Not}$ | 7.06 ± 0.03$^{That}$ | 9.40 ± 0.05$^{And}$ |
| | GE2-H1 | 12.12 ± 0.02$^{Aa}$ | 10.84 ± 0.02$^{Bc}$ | 8.81 ± 0.15$^{Cc}$ | 7.90 ± 0.36$^{Dd}$ |
| | GE2-H2 | 12.35 ± 0.04$^{Aa}$ | 11.60 ± 0.07$^{Not}$ | 9.96 ± 0.10$^{Cd}$ | 9.30 ± 0.15$^{And}$ |
| | Co | 12.10 ± 0.02$^{Aa}$ | 10.16 ± 0.05$^{Bd}$ | 7.79 ± 0.02$^{Cb}$ | 5.59 ± 0.06$^{Of}$ |
| | GE1-H3 | 12.24 ± 0.02$^{Aac}$ | 11.24 ± 0.04$^{Bb}$ | 9.45 ± 0.02$^{Cb}$ | 8.60 ± 0.04$^{Dbc}$ |
| | GE2-H3 | 12.20 ± 0.00$^{Aa}$ | 10.63 ± 0.02$^{Bb}$ | 9.35 ± 0.16$^{BCbc}$ | 8.55 ± 0.00$^{Dc}$ |
| Springiness (mm) | GE1-H1 | 0.93 ± 0.02$^{Acd}$ | 0.95 ± 0.00$^{Bb}$ | 0.93 ± 0.00$^{Cd}$ | 0.87 ± 0.00$^{Of}$ |
| | GE1-H2 | 0.93 ± 0.00$^{Abc}$ | 0.97 ± 0.00$^{Not}$ | 0.94 ± 0.00$^{Cb}$ | 0.91 ± 0.00$^{Ghost}$ |
| | GE2-H1 | 0.94 ± 0.00$^{Oops}$ | 0.95 ± 0.00$^{ABeb}$ | 0.94 ± 0.00$^{Cde}$ | 0.88 ± 0.00$^{Dde}$ |
| | GE2-H2 | 0.93 ± 0.00$^{Abc}$ | 0.98 ± 0.10$^{Not}$ | 0.94 ± 0.00$^{Cab}$ | 0.92 ± 0.00$^{Ghost}$ |
| | Co | 0.94 ± 0.01$^{Aa}$ | 0.96 ± 0.00$^{Bb}$ | 0.91 ± 0.00$^{Cd}$ | 0.85 ± 0.00$^{Df}$ |
| | GE1-H3 | 0.93 ± 0.01$^{Abc}$ | 0.96 ± 0.00$^{Bb}$ | 0.94 ± 0.00$^{Cbc}$ | 0.90 ± 0.00$^{Dcd}$ |
| | GE2-H3 | 0.92 ± 0.00$^{Abc}$ | 0.96 ± 0.00$^{Bb}$ | 0.94 ± 0.00$^{BCab}$ | 0.90 ± 0.00$^{Dbc}$ |
| Cohesiveness | GE1-H1 | 0.58 ± 0.01$^{Aa}$ | 0.51 ± 0.01$^{Bbc}$ | 0.40 ± 0.02$^{Cbc}$ | 0.38 ± 0.01$^{And}$ |
| | GE1-H2 | 0.55 ± 0.00$^{Oops}$ | 0.57 ± 0.02$^{Aa}$ | 0.46 ± 0.02$^{That}$ | 0.45 ± 0.02$^{Of}$ |
| | GE2-H1 | 0.41± 0.02$^{But}$ | 0.51 ± 0.00$^{Babc}$ | 0.41 ± 0.00$^{Cbc}$ | 0.39 ± 0.01$^{Db}$ |
| | GE2-H2 | 0.53 ± 0.01$^{Aabc}$ | 0.53 ± 0.06$^{ABab}$ | 0.45 ± 0.04$^{Cab}$ | 0.44 ± 0.01$^{Df}$ |
| | Co | 0.41 ± 0.02$^{But}$ | 0.50 ± 0.00$^{Bd}$ | 0.35 ± 0.02$^{Cd}$ | 0.31 ± 0.02$^{Dg}$ |
| | GE1-H3 | 0.47 ± 0.02$^{Acd}$ | 0.52 ± 0.04$^{Babc}$ | 0.44 ± 0.02$^{Cbc}$ | 0.43 ± 0.04$^{Dc}$ |
| | GE2-H3 | 0.45 ± 0.02$^{Ade}$ | 0.50 ± 0.04$^{ABbcd}$ | 0.43 ± 0.01$^{Cbc}$ | 0.41 ± 0.02$^{Dd}$ |

(GE1-H1: Coating containing 100 ppm green walnut husk and 5% Chicken feet gelatin, GE1-H2: Coating containing 1000 ppm green walnut husk and 5% Chicken feet gelatin, GE2-H1: Coating containing 100 ppm green walnut husk and 2.5% Chicken feet gelatin, GE2-H2: Coating containing 1000 ppm green walnut husk and 2.5% Chicken feet gelatin, Co : Control sample, GE1-H3: Coating containing 500 ppm green walnut husk and 5% Chicken feet gelatin, GE2-H3: Coating containing 500 ppm green walnut husk and 2.5% Chicken feet gelatin)

The different small or capital letters indicate significant difference at the level of 5% (P <0.05)

## 4- General conclusion

Due to the rapid perishability of marine products, this research was conducted with the aim of investigating the coating of chicken leg gelatin/green walnut skin extract on the preservation of moisture, color indicators and texture of rainbow salmon fillets. According to the results, the gelatin coating/green walnut skin extract was good as a coating in maintaining the quality of fish fillets, so that this quality preservation was more evident with the increase in the concentration of pistachio green skin extract. Based on the obtained results, the samples coated with chicken leg gelatin/green walnut skin extract had the highest amount of moisture at the end of the storage period compared to the control sample.

During 12 days of keeping the fillets in the refrigerator, the amount a*AndL*The

amount of all samples decreased; While the amount of samples showed an increase b*. The coatings significantly prevented the reduction of brightness and redness as well as the increase of yellowness of the fillets. The samples coated with high concentration of green walnut skin extract and chicken foot gelatin on the last day of the storage period had the highest amount of brightness, redness and the least yellowness.

During the examination of the texture of the fillets, the results showed a decrease in hardness and cohesion as well as an increase in elasticity during 12 days of storage in the refrigerator. The result confirmed the preservation of the texture of the fillets coated with chicken feet gelatin/green walnut skin extract. Increasing the concentration of the extract was significantly effective in maintaining the quality. In general, this is how the coverage can be concludedGE2-H2‹ As the best treatment of this research, they can maintain the quality of fish fillets and increase the storage life in the refrigerator. As compared to the control sample, the mentioned coating was able to increase the shelf life of fish fillets in the refrigerator for 7-8 days.

## 6- Resources


[1] Monteiro, M.L.G., Mársico, E.T. and Conte-Junior, C.A., 2020. Application of active packaging in refrigerated Rainbow trout (Oncorhynchus mykiss) fillets treated with UV-C radiation. *Applied Sciences*, *10*(17), p.5787.

[2] Cunha, L.C., Monteiro, M.L.G., Lorenzo, J.M., Munekata, P.E., Muchenje, V., De Carvalho, F.A.L. and Conte-Junior, C.A., 2018. Natural antioxidants in processing and storage stability of sheep and goat meat products. *Food Research International*, *111*, pp.379-390.

[3] Ștefănescu, B.E., Socaciu, C. and Vodnar, D.C., 2022. Recent progress in functional edible food packaging based on gelatin and chitosan.*Coatings*, *12*(12), p.1815.

[4] Nurdiani, R., Ma'rifah, R.D., Busyro, I.K., Jaziri, A.A., Prihanto, A.A., Firdaus, M., Talib, R.A. and Huda, N., 2022. Physical and functional properties of fish gelatin-based film incorporated with mangrove extracts. *PeerJ*, *10*, p.e13062.

[5] Fatima, S., Mir, M.I., Khan, M.R., Sayyed, R.Z., Mehnaz, S., Abbas, S., Sadiq, M.B. and Masih, R., 2022. The optimization of gelatin extraction from chicken feet and the development of gelatin based active packaging for the shelf-life extension of fresh grapes. *Sustainability*, *14*(13), p.7881.

[6] Munteanu, S.B. and Vasile, C., 2019. Vegetable additives in food packaging polymeric materials. *Polymers*, *12*(1), p.28.

[7] Salem, A., Jridi, M., Abdelhedi, O., Fakhfakh, N., Nasri, M., Debeaufort, F. and Zouari, N., 2021. Development and characterization of fish gelatin-based biodegradable film enriched with Lepidium sativum extract as active packaging for cheese preservation. *Hellion*, *7*(10), p.e08099.

[8] Tkaczewska, J., Jamróz, E., Kasprzak, M., Zając, M., Pająk, P., Grzebieniarz, W., Nowak, N. and Juszczak, L., 2022. Edible Coatings Based on a Furcellaran and Gelatin Extract with Herb Addition as an Active Packaging for Carp Fillets.*Food and Bioprocess Technology*, pp.1-13.

[9] Romano, R., Aiello, A., Meca, G., De Luca, L., Pizzolongo, F. and Masi, P., 2021. Recovery of bioactive compounds from walnut (Juglans regia L.) green husk by supercritical carbon dioxide extraction. *International Journal of Food Science & Technology*, *56*(9), pp.4658-4668.

[10] Barekat, S., Nasirpour, A., Keramat, J., Dinari, M., Meziane-Kaci, M., Paris, C. and Desobry, S., 2022. Phytochemical Composition, Antimicrobial, Anticancer Properties, and Antioxidant Potential of Green Husk from Several Walnut Varieties (Juglans regia L.). *Antioxidants*, *12*(1), p.52.

[11] Ahmadvand, H., Shahsavari, G., Abdolahpour, F., & Bagheri, S. 2011. The inhibitory effects of Walnut (Juglansregia L.) huskhydroalcoholic extract on LDL oxidation in vitro. *Journal of Jahrom University of Medical Sciences*, *9*(3), 1-7.

[12] Omrani Fard, H., Abbaspour- Fard, M. H., Khojastehpour, M., Dashti, A. 2019. Extraction and characterization of gelatin from chicken feet and its application in cantaloupe jelly. Iranian Food Science and Technology, 15(2): 309-322.

[13] Afshar, N., Sedaghat, N. and Mohsenzadeh, M., 2022. Effect of Edible Chicken Feet Gelatin Green Walnut Husk Extracted Coating on Chemical, Physical, Sensory Properties and Storage Time of Refrigerated Temperature Rainbow Trout Fillets (5.0±1.0° C). *Journal of food science and technology (Iran)*, *19*(128), pp.37-56. (In Persian)

[14] Yingyuad, S., Ruamsin, S., Reekprkhon, D., Douglas, S., Pongamphai, S. and Siripatrawan, U.,

2006. Effect of chitosan coating and vacuum packaging on the quality of refrigerated grilled pork. *Packaging technology and science: An international journal*, *19*(3), pp.149-157.
[15] AOAC. 1995. Official methods of analysis, Association of official analytical chemists, INC., Arlington, Virginia, USA.
[16] Jafarpour, A., & Gorczyca, E. M. (2009). Rheological characteristics and microstructure of common carp (cyprinus carpio) surimi and kamaboko gel. *Food biophysics*, *4*, 172-179.
[17] Tsghizadeh, A. G., & Rezaei, M. (2013). Effect of gelatin coatings on chemical, microbial and sensory properties of refrigerated rainbow trout fillet (Oncorhynchus mykiss). *FSCT* 2012; 9 (37) :67-76. (In Persian)
[18] Lee, J.H., Lee, J. and Song, K.B., 2015. Development of a chicken feet protein film containing essential oils. *Food Hydrocolloids*, *46*, pp.208-215.
[19] Ruiz-Razors , Y. , Widow-Martos , M. , Barber , X. , Sendra , E. , Perez-Alvarez , J.A. and Fernandez-Lopez, J., 2015. Effect of chitosan edible films added with Thymus moroderi and Thymus piperella essential oil on shelf-life of cooked cured ham.*Journal of Food Science and Technology*, *52*, pp.6493-6501.
[20] Jahanban-Esfahlan, A., Ostadrahimi, A., Tabibiazar, M. and Amarowicz, R., 2019. A comparative review on the extraction, antioxidant content and antioxidant potential of different parts of walnut (Juglans regia L.) fruit and tree. *Molecules*, *24*(11), p.2133.
[21] Rodrigues, F. J., Cedran, M. F., & Garcia, S. (2018). Influence of linseed mucilage incorporated into an alginate-base edible coating containing probiotic bacteria on shelf-life of fresh-cut yacon (Smallanthus sonchifolius). *Food and Bioprocess Technology*, *11*, 1605-1614.
[22] Pelaes Vital , A.C. , Guerrero , A. , Guarnido , P. , Lamb Severino , I. , Pot , J.L. , Blasco , M. , Nunes do Prado , I. , Maggi , F. and Field , M.D.M Effect of active-edible coating and essential oils on oxidation of lamb patties during display .*Foods*, *10*(2), p.263.
[23] Pourmolaei, F., Jafarpour, A. and Yeganeh, S., 2017. The Antioxidative and Antibacterial Effect of Origanum Vulgare Essential oil on Surimi Shelf life during Frozen Storage. *Journal of Fisheries*, *70*(1), pp.44-59.
[24] Lu, F., Ding, Y., Ye, X. and Liu, D., 2010. Cinnamon and nisin in alginate–calcium coating maintains quality of fresh northern snakehead fish fillets. *LWT-Food Science and Technology*, *43*(9), pp.1331-1335.
[25] Yu, D., Regenstein, J.M. and Xia, W., 2019. Bio-based edible coatings for the preservation of fishery products: A review. *Critical reviews in food science and nutrition*, *59*(15), pp.2481-2493.
[26] Mancini, R.A. and Hunt, M., 2005. Current research in meat color. *Meat science*, *71*(1), pp.100-121.
[27] Fang, Z., Lin, D., Warner, R.D. and Ha, M., 2018. Effect of gallic acid/chitosan coating on fresh pork quality in modified atmosphere packaging. *Food Chemistry*, *260*, pp.90-96.
[28] Chaharlang, M., Daneshniya, M., Barzanooni, M. and Boghori, P., 2021. Antioxidant and antimicrobial properties of methanolic extract of green walnut skin. *Journal of food science and technology (Iran)*, *17*(108), pp.127-136.
[29] Linares, M.B., Berruga, M.I., Bórnez, R. and Vergara, H., 2007. Lipid oxidation in lamb meat: Effect of the weight, handling previous slaughter and modified atmospheres. *Meat science*, *76*(4), pp.715-720.
[30] Zhang, H., Wu, J. and Guo, X., 2016. Effects of antimicrobial and antioxidant activities of spice extracts on raw chicken meat quality. *Food Science and Human Wellness*, *5*(1), pp.39-48.
[31] Rant, W., Radzik-Rant, A., Świątek, M., Niżnikowski, R., Szymańska, Ż., Bednarczyk, M., Orłowski, E., Morales-Villavicencio, A. and Ślęzak, M., 2019 The effect of aging and muscle type on the quality characteristics and lipid oxidation of lamb meat.*Archives Animal Breeding*, *62*(2), pp.383-391.
[32] Wang, F., Zhang, H., Jin, W. and Li, L., 2018. Effects of tartary buckwheat polysaccharide combined with nisin edible coating on the storage quality of tilapia (Oreochromis niloticus) fillets. *Journal of the Science of Food and Agriculture*, *98*(8), pp.2880-2888.
[33] Pearce, K.L., Rosenvold, K., Andersen, H.J. and Hopkins, D.L., 2011. Water distribution and mobility in meat during the conversion of muscle to meat and ageing and the impacts on fresh meat quality attributes—A review. *Meat science*, *89*(2), pp.111-124.
[34] Lyhs, U., Lahtinen, J. and Schelvis-Smit, R., 2007. Microbiological quality of maatjes herring stored in air and under modified atmosphere at 4 and 10 C. *Food microbiology*, *24*(5), pp.508-516.
[35] Christensen, M., Ertbjerg, P., Failla, S., Sañudo, C., Richardson, R.I., Nute, G.R., Olleta, J.L., Panea, B., Albertí, P., Juárez, M. and Hocquette, J.F., 2011. Relationship between collagen characteristics, lipid content and raw and cooked texture of meat from young bulls of fifteen European breeds. *Meat Science*, *87*(1), pp.61-65.
[36] Zhao, Y., Kong, H., Zhang, X., Hu, X. and Wang, M., 2019. The effect of Perilla (Perilla frutescens) leaf extracts on the quality of surimi fish balls. *Food Science & Nutrition*, *7*(6), pp.2083-2090.

[37] Hultmann, L. and Rustad, T., 2002. Textural changes during iced storage of salmon (Salmo salar) and cod (Gadus morhua). *Journal of Aquatic Food Product Technology*, *11*(3-4), pp.105-123.

[38] Merlo, T.C., Contreras-Castillo, C.J., Saldana, E., Barancelli, G.V., Dargelio, M.D.B., Yoshida, C.M.P., Junior, E.E.R., Massarioli, A. and Venturini, A.C., 2019. Incorporation of pink pepper residue extract into chitosan film combined with a modified atmosphere packaging: Effects on the shelf life of salmon fillets. *Food Research International*, *125*, p.108633.

[39] Yerlikaya, P. and Gökoğlu1ge, N., 2010. Effect of previous plant extract treatment on sensory and physical properties of frozen bonito (Sarda sarda) filllets. *Turkish Journal of Fisheries and Aquatic Sciences*, *10*(3).

[40] Cai, L., Cao, A., Li, T., Wu, X., Xu, Y. and Li, J., 2015. Effect of the fumigating with essential oils on the microbiological characteristics and quality changes of refrigerated turbot (Scophthalmus maximus) fillets. *Food and Bioprocess Technology*, *8*, pp.844-853.

**مجله علوم و صنایع غذایی ایران**

**سایت مجله:** www.fsct.modares.ac.ir

**مقاله علمی_پژوهشی**

# ارزیابی پوشش خوراکی بر پایه ژلاتین پای مرغ/ عصاره پوست سبز گردو بر ویژگی‌های فیزیکی، خوصیات رنگی و بافتی فیله ماهی قزل آلا رنگین کمانی طی شرایط نگهداری در یخچال

نسرین افشار[۱]، سید حسین سید قوامی[۲]، ناصر صداقت*[۳]

دانش‌آموخته کارشناسی ارشد علوم و صنایع غذایی، دانشکده کشاورزی، دانشگاه فردوسی مشهد، مشهد، ایران.

دانش‌آموخته کارشناسی ارشد علوم و صنایع غذایی، دانشکده علوم پایه، دانشگاه آزاد اسلامی، واحد لاهیجان، ایران.

استاد گروه بهداشت مواد غذایی و آبزیان، دانشکده کشاورزی، دانشگاه فردوسی مشهد، مشهد، ایران.

**اطلاعات مقاله**

**تاریخ های مقاله :**

**تاریخ دریافت: ۱۴۰۲/۱/۱۱**

**تاریخ پذیرش: ۱۴۰۲/۳/۲۳**

**کلمات کلیدی:**

پوشش خوراکی،

ژلاتین پای مرغ،

عصاره پوست سبز گردو،

ماهی،

نگهداری

**DOI: 10.22034/FSCT.20.142. 1**

**DOR:20.1001.1.20088787.1402.20.142.1.1**

* مسئول مکاتبات:

sedaghat@um.ac.ir

**چکیده**

با توجه به فسادپذیری بالا، کاهش کیفی و ارزش تغذیه‌ای ماهی طی مدت زمان نگهداری، این مطالعه با هدف بررسی پوشش خوراکی بر پایه ژلاتین پای مرغ/ عصاره پوست سبز گردو بر حفظ ویژگی‌های فیزیکی، خوصیات رنگی و بافتی فیله‌ماهی قزل آلا رنگین کمانی طی شرایط نگهداری در یخچال انجام شد. پس از استخراج ژلاتین و عصاره پوست سبز گردو، محلول‌های پوشش‌دهی تهیه و فیله‌ها به روش غوطه‌وری پوشش‌دهی شدند. خصوصیات فیزیکی (رطوبت)، شاخص‌های رنگی (L*، a* و b*) همچنین خصوصیات بافتی (سختی، کشسانی و انسجام) فیله‌ها طی ۱۲ روز نگهداری (در روزهای ۰، ۴، ۸ و ۱۲) ارزیابی شد. آنالیز واریانس توسط نرم افزار مینی‌تب (نسخه ۱۸) انجام گردید. مقایسه میانگین داده‌ها توسط آزمون توکی و در سطح اطمینان ۹۵ درصد انجام شد. نتایج نشان دهنده حفظ رطوبت معنادار فیله‌های پوشش داده شده بود ($p<0.05$). کاهش شاخص روشنایی و قرمزی فیله‌ها طی ۱۲ روز نگهداری گزارش شد. درحالیکه شاخص b* در تمامی نمونه‌ها افزایش یافت ($p<0.05$). پوشش‌دهی فیله‌ها در حفظ ویژگی‌های رنگی فیله‌ها بطور معناداری موثر بودند ($p<0.05$). ارزیابی بافت فیله‌ها کاهش سختی و انسجام همچنین افزایش کشسانی بافت را نشان داد ($p<0.05$). تیمارهای پوشش داده شده بطورمعناداری سختی، انسجام بالاتر و کشسانی کمتری نسبت به نمونه شاهد داشتند ($p<0.05$). افزایش غلظت عصاره پوست سبز گردو از ۵۰۰ به ۱۰۰۰ ppm سبب افزایش حفظ بهتر کیفیت فیله‌ها شدند ($p<0.05$). بطورکلی می‌توان نتیجه‌گیری کرد استفاده از پوشش خوراکی بر پایه ژلاتین پای مرغ/ عصاره پوست سبز گردو به عنوان یک عامل افزایش ماندگاری در صنعت آبزی‌پروری می‌تواند بطور موثر واقع شوند.