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Effects of Zein edible coating containing barberry extract and onion (*Allium cepa)* essential oil on the oxidative shelf life enhancement of chicken breast meat

Mousavi Parsa, D.[1] Bazargani-Gilani, B. [2*], Pajohi-Alamoti, M. R. [2]

1. Msc., Department of Food Hygiene and Quality Control, Faculty of Veterinary Medicine, Bu-Ali Sina University, Hamedan, Iran

2. Associate Prof., Department of Food Hygiene and Quality Control, Faculty of Veterinary Medicine, Bu-Ali Sina University, Hamedan, Iran

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*Corresponding Author E-

behnazbazargani90@gmail.com

b.bazargani@basu.ac.ir

ABSTRACT

This study was investigated to introduce a new and palatable product resulting from dipping of chicken breast meat in barberry extract (BE) and Corn Zein coating (CZ) enriched with *Allium cepa* essential oil (AEO) during refrigerated storage. Barberry ethanolic extract significantly showed the highest antioxidant activity as compared to the other extracts (P≤0.05). Treatments examined in the present study were the following: dipped samples in sterile distilled water as control (C), dipped samples in 1.5% barberry extract (BE1.5%), dipped samples in barberry extract 3% (BE3%), dipped samples in barberry extract 1.5% and Corn Zein (BE1.5%-CZ), dipped samples in barberry extract 3% and Corn Zein (BE3%-CZ), dipped samples in barberry extract 1.5%, Corn Zein and onion essential oil 2% (BE1.5%-CZ-AEO2%) and dipped samples in barberry extract 3%, Corn Zein and onion essential oil 2% (BE3%-CZ-AEO2%). The samples were stored at 4±1 °C and Chemical, and sensorial analyses were performed at 3-day intervals to determine the overall quality of samples for 15 days. Peroxide, Thiobarbituric acid reactive substance (TBARS) and pH values were significantly lower in all treatments than control (P≤0.05). Sensory evaluation revealed that BE gave a pleasant effect on sensory attributes (taste, odor, color, texture and over all acceptability). Also Corn Zein coating enriched with AEO2% significantly improved all of these characteristics (P≤0.05). BE3%-CZ-AEO2% treatment was the most efficient group in shelf life enhancement of the samples and BE1.5%-CZ-AEO2%, BE3%-CZ, BE1.5%-CZ, BE3% and BE1.5% were in the next ranks, respectively. It was concluded that barberry extract with Corn Zein coating containing onion essential oil can be suggested as a good substitute for preservatives as well as for chemical flavors in chicken breast meat during refrigerated conditions.

1.Introduction

Chicken meat is popular around the world due to its easy cooking, abundance, variety of products derived from it, and affordability compared to other types of edible meat. On the other hand, this product is highly susceptible to chemical and microbial spoilage due to its high protein content, moisture, and the presence of oxygen. Therefore, the shelf life of this product is very short. As a result, the food industry today is seeking solutions to increase its shelf life. One such solution is the use of chemical preservatives to reduce microbial growth and extend the shelf life of meat [1]. However, due to some side effects of these preservatives, such as carcinogenicity and teratogenicity, and considering the increasing demand from consumers for healthier meals (free from old chemical preservatives), the focus today in the industry is on using natural preservatives, predominantly of plant origin, and employing healthier compounds [2, 3]. One of these natural substances is the barberry plant, scientifically known as *Berberis vulgaris* L. This plant is cultivated in South Khorasan province in eastern Iran. The fruit of the barberry plant is a popular seasoning in Iranian dishes and is typically served with rice alongside cooked chicken, known as "zereshk polo ba morgh," giving it a flavorful and widely enjoyed taste. In addition to the unique flavor of the barberry fruit, numerous studies have reported the antioxidant and antimicrobial effects of the extracts from this fruit [4]. Previous studies indicate that the fruit of the barberry plant is rich in ascorbic acid, vitamin K, various triterpenoids, more than 10 phenolic compounds, and 30 alkaloid compounds [5, 6]. On the other hand, today, due to the sensitivity of natural compounds to the presence of oxygen and the need to prevent their deactivation while extending their effectiveness in food products, the use of edible coatings can be very beneficial. Additionally, edible coatings can serve as a barrier against oxygen, leading to better preservation of food quality. Corn zein edible coating is biodegradable and is a natural substance that has a glossy appearance, high strength, low solubility in water, resistance to bacterial attack, and also exhibits high hydrophobicity. So far, there has been limited research on its application in food products. The corn zein edible coating helps preserve the aroma and moisture of food. Corn zein is an insoluble protein in water and is considered the only commercially extracted protein from corn. Studies indicate that corn zein coating has a very good potential for combining with other materials, especially lipids [7-9]. Recently, various plant essential oils with medicinal properties are used to enhance the effectiveness of edible coatings. Among these plants is the onion, scientifically known as Allium cepa, which has a very strong aroma and flavor. This plant is widely used in various food products. The essential oil of this plant possesses several important biological properties, including antimicrobial properties that cover a wide range of microorganisms such as various bacteria, molds, and yeasts. Furthermore, this plant also has antioxidant and disinfectant properties due to the presence of compounds such as phenolic and organosulfur compounds [10, 11]. Considering the high perishability of chicken meat and the need for healthy preservation methods, the aim of this research is to introduce a new coating made from corn zein containing a combination of barberry extract and onion essential oil as a natural preservative for the oxidative preservation of chicken breast stored at refrigeration temperatures.

2. Materials and Methods

2.1. Materials

Corn zein protein, glycerol, butylated hydroxytoluene (BHT), 2,2'-azino-bis 3-ethylbenzothiazoline-6-sulfonic acid (ABTS), 2,2-diphenyl-1-picrylhydrazyl (DPPH), and potassium persulfate were obtained from the Sigma Aldrich company (Germany). Methanol, chloroform, hexane, isopropanol, sodium sulfate, ammonium thiocyanate, iron (II) and (III) chloride, sodium hydroxide, perchloric acid, trichloroacetic acid, thiobarbituric acid, disodium hydrogen phosphate, sodium dihydrogen phosphate, and sodium carbonate were sourced from the Merck company (Germany). Onion essential oil was commercially purchased from Argoul (France) and fresh barberry fruits were bought from the local market, Hamedan, Iran.

2.2. Barberry fruit extraction

Fresh barberry fruits were dried for two weeks under suitable conditions (away from light and heat, in the shade). The obtained sample was ground into powder using a home grinder. Then, the barberry fruit powder was mixed with solvents of ethanol (50% and absolute), acetone (50% and absolute), methanol (50% and absolute), cold water (distilled water at room temperature), and hot water (reflux) at a ratio of 1:10, and was extracted using three methods: immersion, ultrasound, and a combined method (ultrasound along with immersion). In the immersion method with cold water, the samples were placed on an Erlenmeyer shaker for 24 hours at a speed of 150 rpm, at room temperature, and in darkness. For extraction with hot water, 20 g of barberry powder were mixed with 200 ml of distilled water and heated for 1 h in a reflux set. In the ultrasound method, the resulting solution was placed in an ultrasonic device for 30 minutes at a temperature of 25 °C, with a cycle of 70, power of 50 watts, and a frequency of 20 kHz. In the combined method, the extracts were initially extracted using the ultrasound method and then placed on an Erlenmeyer shaker for 24 h under the aforementioned conditions. After the extraction time, the extracts were filtered using Whatman filter paper number one, completely separating the solid part. The solvent was evaporated using a rotary evaporator at a temperature of 40 °C, and the extract was concentrated. The dried extracts were then stored in airtight containers in a freezer at -18 °C until use [12, 13].

2.3. Evaluation of antioxidant activity of extracts

2.3.1. DPPH radical scavenging activity

The ability to scavenge the DPPH free radical was measured using the method of Blois et al. (1958) [14]. 50 µl of the extract were mixed with 2 ml of a DPPH solution (24 µg/ml) and vortexed. The resulting solution was kept in the dark at room temperature for 60 minutes. The optical absorbance of the samples was then read at a wavelength of 517 nm using a spectrophotometer. Finally, the percentage of DPPH radical inhibition by the extract was calculated using the following formula:

$$RSA(\%) = \frac{\text{Ablank} - \text{Asampel}}{\text{Ablank}} \times 100$$

A blank: The optical absorbance of blank (2 ml of DPPH solution and 50 µl of methanol).
A sample: The optical absorbance of samples.
For the positive control, a BHT solution with a concentration of 2 mg/ml was used.

2.3.2. ABTS radical scavenging activity

ABTS (7 mmol) and potassium persulfate (45/2 mmol) solutions were prepared. The resulting solutions were then mixed together and left in the dark at room temperature for 16 h. In the next step, the obtained ABTS solution was diluted using phosphate buffer (PBS) until it reached an optical density of 0.02±0.7 at a wavelength of 734 nm. Then, 200 µl of the samples were added to 2 ml of the ABTS solution, mixed together, and after 1 min of incubation at room temperature, read using a spectrophotometer at a wavelength of 734 nm [15]. The percentage of inhibition of ABTS free radicals was calculated using the following formula:

$$ABTS\ radical\ scaveging\ activity\ (\%) = \frac{\text{Ablank} - \text{Asampel}}{\text{Ablank}} \times 100$$

A blank: Optical absorbance of blank (including all materials except the sample).
A sample: Optical absorbance of the samples. For the positive control, BHT solution with a concentration of 2 mg/ml.

2.4. Immersing and coating of chicken breast samples

To prepare the coating solution, corn zein powder (20% w/v) was dissolved in ethanol (96%), and glycerol (4% w/v) was used as a plasticizer. The resulting solution was then boiled for 5 min. Before coating, the solution was filtered and cooled to 4 °C. To prepare the corn zein solution containing onion essential oil, after completing the aforementioned steps for uniform and complete dispersion of the essential oil in the corn zein solution, the desired essential oil was first mixed with Tween 80 (at a concentration of 0.2% w/v) and then added to the final corn zein

solution. Subsequently, chicken breast samples were randomly divided into 7 groups as follows: 1- Coated samples with sterile distilled water (control group), 2- Coated samples with 1.5% barberry extract (BE1.5%), 3- Coated samples with barberry extract (3%) (BE3%), 4- Coated samples with barberry extract (1.5%) and corn zein coating (BE1.5%-CZ), 5- Coated samples with barberry extract (3%) and corn zein coating (BE3%-CZ), 6- Coated samples with barberry extract (1.5%) and corn zein coating containing onion essential oil (2%) (BE1.5%-CZ-AEO2%), 7- Coated samples with barberry extract (3%) and corn zein coating containing onion essential oil (2%) (BE3%-CZ–AEO2%). Chicken breast samples were immersed in the prepared solutions for 2 min, drained, dried, and then packaged in sterilized zip bags. Finally, the samples were stored in a refrigerator at 4 °C and evaluated for chemical and sensory properties on 0, 3, 6, 9, 12, and 15 days [2].

2.5. Chemical analysis of samples

2.5.1. pH Measurement

To evaluate the pH values, 5 g of meat samples were placed in Falcon tubes along with 25 ml of distilled water and homogenized using a homogenizer for 30 seconds. Then, using a pH meter, the pH of the meat samples was measured at room temperature [16].

2.5.2. PV measurement

In order to measure the peroxide value, 0.3 g of the homogenized sample was vortexed with 9.8 ml of a chloroform:methanol solvent in a 7:3 ratio for 2 to 4 seconds. It was then filtered using Whatman filter paper number 1. Next, 0.05 ml of ammonium thiocyanate solution (10 mmol) was added and vortexed for 2 to 4 seconds. After adding 0.05 ml of iron(II) solution, it was vortexed again for 2 to 4 seconds. After 5 min of incubation at room temperature, the optical absorbance was read at 500 nm [17].

2.5.3. Measurement of tubarbituric acid index

10 g of meat samples were mixed with 1 ml of BHT (1 mg/mL) and 35 ml of trichloroacetic acid (5%), and homogenized for 1 min at 13,500 rpm. The mixture was then filtered using Whatman filter paper number 1 and made up to a volume of 50 ml with trichloroacetic acid. In the next step, 5 ml of the resulting solution was mixed with 5 ml of 0.02 M TBA solution, and after shaking, it was placed in a water bath at boiling temperature for 1 hour. After cooling, the absorbance of the samples at a wavelength of 532 nm was measured using a spectrophotometer [18].

2.6. Sensory analysis

To evaluate sensory characteristics, 10 students of Food Hygiene and Quality Control Department (aged 20-30 years) who were fully familiar with the sensory properties of meat were selected. Necessary training on how to assess each of the factors was provided to the evaluators in advance. Meat samples were presented in the form of grilled kebabs containing 2% salt (Fig 6). Sensory characteristics such as taste, odor, color, texture, and overall acceptability were evaluated. 5-point hedonic scale was employed for scoring, where 1: inedible or very poor, 2: unacceptable or poor, 3: acceptable or average, 4: satisfactory or good, and 5: very satisfactory or excellent [19].

2.7. Statistical analysis

for conducting various experiments involved examining 3 separate samples from each batch for each stage of the test (experiments were conducted in all stages with 3 repetitions). The statistical analysis of the data was performed using ANOVA (Analysis of Variance) and SPSS software version 22, and mean comparisons were made using the Tukey test, with P values of 0.05 or less considered significant. Graphs were also created using Excel software. Additionally, the data were presented in tables and figures as mean ± standard deviation (SD).

3. Results and Discussion

3.1. Evaluation of antioxidant activity of barberry extracts (BE) using DPPH test

DPPH test is one of the simplest methods for evaluating the antioxidant activity of plant extracts [20]. In the DPPH test, antioxidants react with the stable DPPH radical, reducing it by donating hydrogen or electrons, which leads to a discoloration or even de-colorization of the solution. With an increase in the concentration of phenolic compounds or the degree of hydroxylation of phenolic compounds, the radical scavenging activity of the essential oil or extract increases [1]. According to Fig 1, after BHT, the highest percentage of free radical inhibition

corresponds to ethanolic extract (50%) in the ultrasound method (87.662%). In all extracts, except for the absolute acetone extract, the ultrasound method significantly shows the highest percentage of inhibition ($P \leq 0.05$). In most extracts, the combined method shows the lowest antioxidant activity. Additionally, according to the Fig 1, the ability of the extracts to inhibit free radicals is not dependent on the solvent concentration, and increasing the solvent concentration does not enhance their radical scavenging activity. Previous studies have reported that the ethanolic extract obtained from Berberis fruit possesses antioxidant properties that inhibit DPPH free radicals. The antioxidant property of this extract is attributed to the presence of phenolic compounds such as flavonoids and phenolic acids in its polar structure [21]. A study on guava extract reported that the extract obtained using the ultrasonic method performed better in extracting antioxidant compounds compared to the extract obtained through immersion and reflux methods [22].

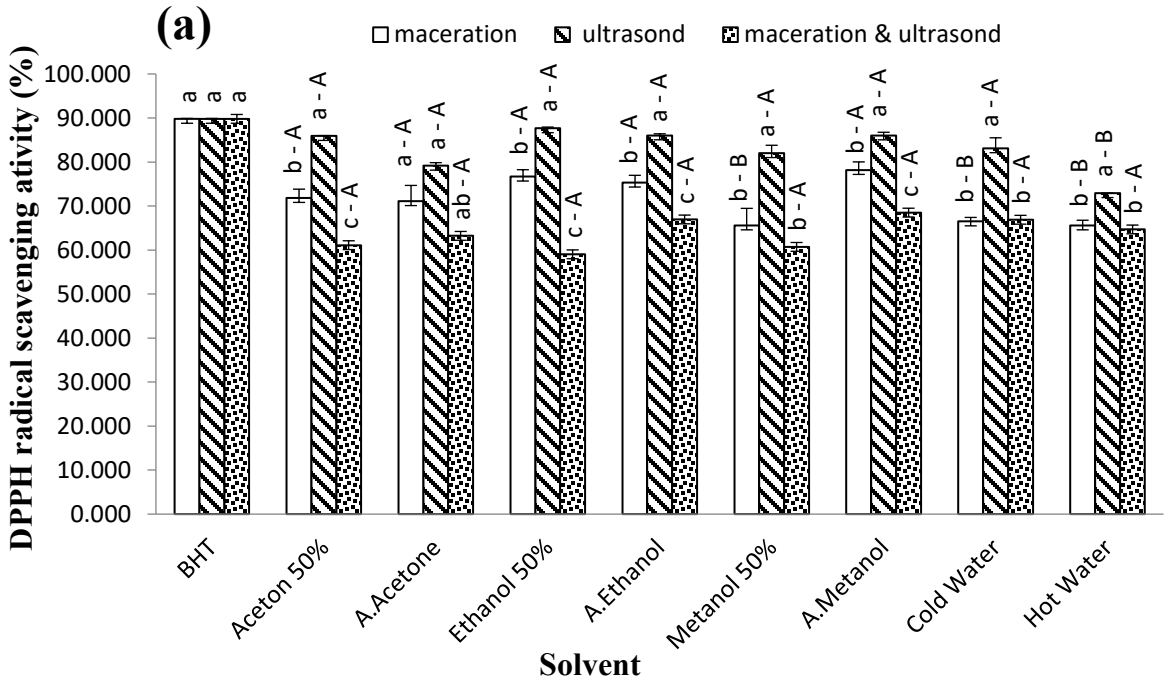

Fig 1 DPPH radical scavenging activity of the barberry extracts by three extraction methods. Different letters whithin the same solvent (a, b, and c) and the same method (A, B, and C) indicate a statistically significant difference ($P \leq 0.05$).

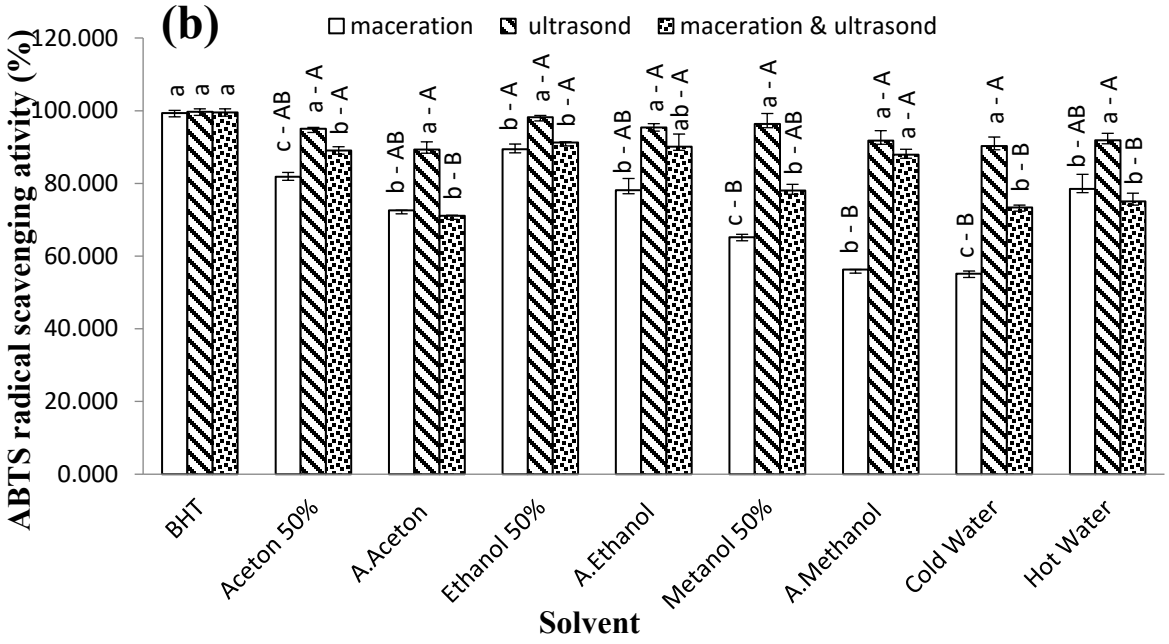

Fig 2 ABTS radical scavenging activity of the barberry extracts by three extraction methods. Different letters whithin the same solvent (a, b, and c) and the same method (A, B, and C) indicate a statistically significant difference (P≤0.05).

3.2. Evaluation of antioxidant activity of barberry extracts (BE) using ABTS test

The ABTS radical is soluble in both aqueous and organic solvents. Therefore, this method can evaluate the antioxidant activity of both hydrophilic and lipophilic compounds [12]. According to Fig 2, which shows the ability to inhibit ABTS free radicals by barberry extracts, the highest inhibitory effect after BHT is related to the ethanolic extract (50%) using the ultrasound method (98.169%). Additionally, in comparing the methods, the ultrasound extraction method significantly achieved the highest percentage in extracting antioxidant compounds for most solvents ($P \leq 0.05$). However, no significant difference was observed between the immersion and combined methods. In comparing solvents in the ultrasound method, no significant difference was found among the solvents ($P \geq 0.05$). In the immersion method, the ethanol (50%) solvent showed significantly higher inhibitory effects compared to methanol (50%), absolute methanol, and cold water ($P \geq 0.05$). In the combined method, the solvents of ethanol (50%), absolute ethanol, acetone (50%), and absolute methanol showed significantly higher percentages of inhibition compared to the other solvents ($P \geq 0.05$). In agreement with the results of this study, another study examined the effect of extraction conditions on the antioxidant activity of barberry fruit extracts and reported that acetone and ethanol solvents had the highest radical scavenging power against ABTS free radicals compared to other solvents [13]. According to the results obtained in another study, ethanolic extract (50%) of tomato pomace exhibited the highest inhibitory effect against ABTS free radicals compared to other solvents (water, acetone, and methanol) [12].

3.3. Chemical analysis of treatments

3.3.1. pH changes

In Fig 3, the changes in the pH values of chicken breast meat samples are shown during refrigerated storage. The initial pH of the studied samples ranged from 5.74 to 5.81, which is similar to the results obtained in previous studies [23]. The results of this research indicated that the pH gradually increased for all samples; however, this increase was significantly more pronounced in the control group compared to the other treatments ($P \leq 0.05$). The increase in pH in the control treatment may be related to endogenous tissue enzymes as well as microbial enzymes

such as proteases or lipases, which lead to the production of volatile bases (such as ammonia and trimethylamine) and may also be associated with the denaturation of proteins and the accumulation of their precursors during prolonged storage [24]. From day 9 onwards, treatments containing extracts, coatings, and essential oils (BE3%-CZ-AEO2% and BE1.5%-CZ-AEO2%) significantly slowed the increase in pH compared to all other treatments ($P \leq 0.05$). This effect is likely due to the acidic properties (the presence of various acids such as malic acid and tartaric acid) of the barberry extract and the antibacterial (sulfur compounds) and antioxidant (flavonoids) properties of the onion essential oil [25, 13]. Our results are consistent with previous studies that examined the effect of corn zein coating containing ginger essential oil and apple peel extract on the chemical, microbiological, and sensory characteristics of chicken thigh meat, observing an increase in the pH of the studied samples with an increase in the storage duration [1]. Another study also reported an increase in the pH of chicken breast meat containing a phenolic solution of pomegranate juice during storage under refrigeration conditions [2]. Additionally, another study reported the prevention of pH increase in chicken meat treatments containing chitosan edible coating and thyme essential oil during storage at refrigeration temperature, which may be due to the acidic nature of the coating used [26]. In another study, researchers reported that treatments containing barberry extract significantly managed to control the increase in pH compared to the control group in sausage samples, which may be due to the extract's ability to inhibit and reduce bacterial growth, thus decreasing spoilage.

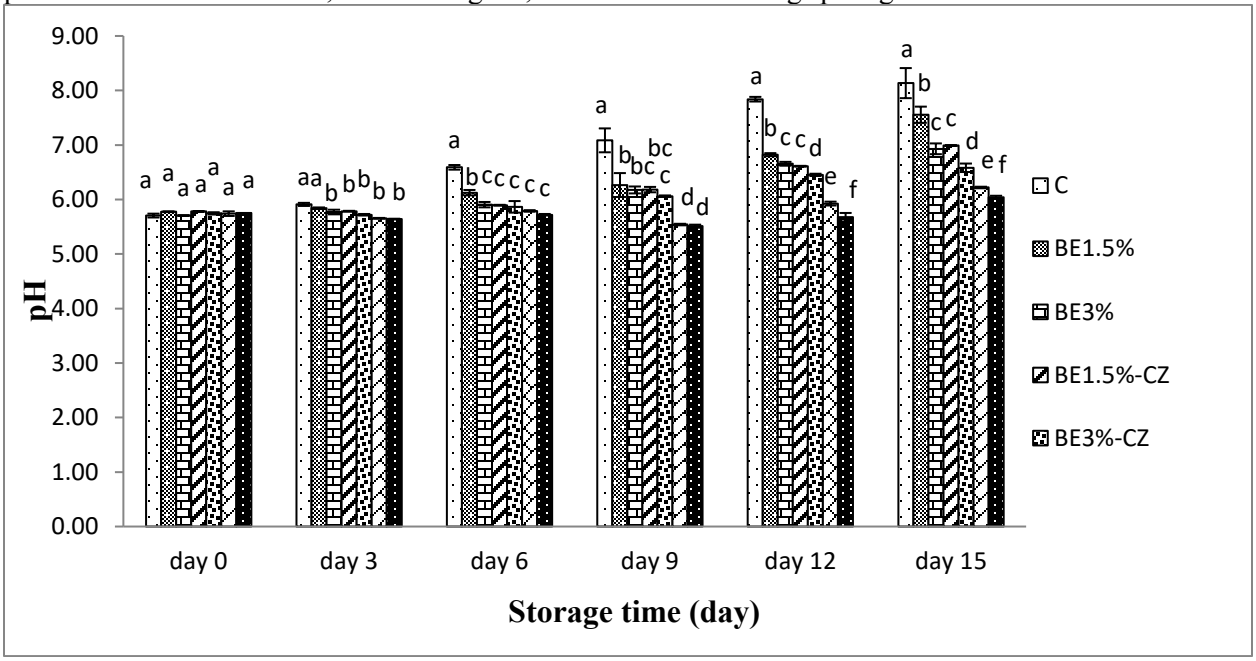

Fig 3 Changes in pH value of chicken breast meat during refrigerated storage. Non-identical letters indicate a significant difference in confidence level of 95%

3.3.2. PV changes

Lipid oxidation is one of the factors contributing to off-flavors in meat products, especially when the meat contains high levels of unsaturated fatty acids and is stored under aerobic conditions [7]. The primary products of fat oxidation (hydroperoxides) are evaluated using the peroxide value (PV), which is an indicator of fat oxidation [27]. Peroxides are odorless and tasteless compounds that are not detected by consumers, but they create off-flavors and odors in the product by forming secondary compounds such as aldehydes and ketones [28]. Fig 4 shows the changes in peroxide levels (PV) in chicken breast meat during storage at 1±4°C for 15 days. In the control treatment, the peroxide level increased until the sixth day of storage, while in the other treatments, it increased until the ninth day. The peroxide level in the control treatment

increased from 0.07 to 0.81 milliequivalents per kilogram of chicken breast by the sixth day and decreased to 0.43 by the fifteenth day. In the treatments BE1.5%, BE3%, BE1.5%-AEO, B3%-CZ, BE1.5%-CZ-AEO2%, and BE3%-CZ-AEO2%, the peroxide levels increased from 0.07 to 0.61, 0.08 to 0.55, 0.07 to 0.44, 0.07 to 0.39, 0.08 to 0.24, and 0.07 to 0.21 milliequivalents per kilogram of chicken breast, respectively, by the ninth day, and then decreased by the fifteenth day to 0.35, 0.31, 0.25, 0.18, 0.11, and 0.09 milliequivalents per kilogram of chicken breast. A similar pattern of results has been reported by other studies on raw salted ground chicken breast and raw chicken breast [30, 29]. According to our findings, barberry extract slowed down the fat oxidation process and significantly inhibited the increase in peroxide levels in all treatments compared to the control group ($P \leq 0.05$). Additionally, our results showed that corn zein edible coating and onion essential oil improved the antioxidant activity of barberry extract, and the treatments containing extract, coating, and essential oil significantly exhibited the highest inhibition of peroxide level increase ($P \leq 0.05$). In a study by Bazargani- Gilani et al. (2015), the peroxide index of chicken breast samples stored in refrigeration with pomegranate juice and chitosan coating enriched with Shirazi thyme essential oil was significantly lower than the control group [28].

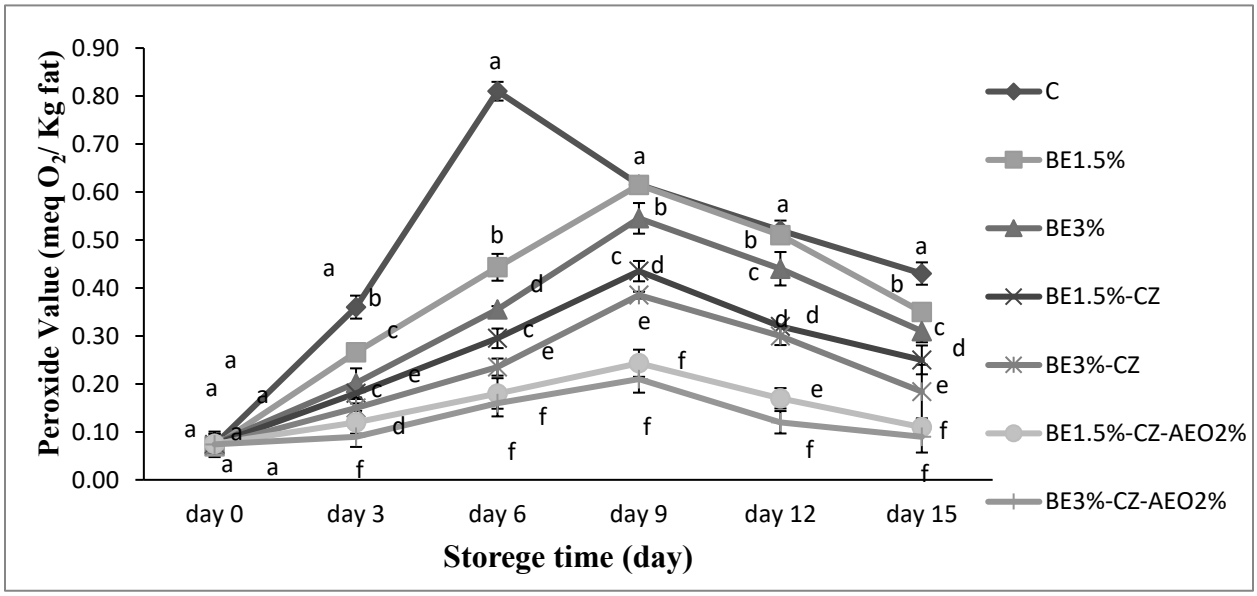

Fig 4 Changes in peroxide value (meq O_2/kg fat) of chicken breast meat during refrigerated storage. Non-identical letters indicate a significant difference in confidence level of 95%

3.3.3. TBARS changes

The analysis of TBARS results for chicken meat samples over storage time is shown in Fig 5. All treatments significantly inhibited the increase in malondialdehyde (MDA) levels compared to the control group ($P \leq 0.05$). Overall, the fat oxidation in all groups was lower than 0.5 mg malondialdehyde/kg of meat. In both the control group and all treatments, an initial increasing trend in malondialdehyde levels was observed up to the sixth and twelfth days, respectively, followed by a significant decrease in the subsequent days. Fat oxidation is typically evaluated by the index of Thiobarbituric Acid Reactive Substances (TBARS), which indicates the amount of secondary oxidation products, particularly aldehydes [31]. Aldehydes are formed from the decomposition or oxidation of hydroperoxides, and the TBARS index is expressed in milligrams of malondialdehyde per kilogram of fat [8]. Ultimately, fat oxidation in chicken meat leads to the formation of aldehydes, ketones, acids, and alcohols, resulting in undesirable changes in the aroma and flavor of the meat and reducing its nutritional value [1]. According to our findings, the level of

malondialdehyde in all treatments initially began to increase and then started to decrease after a while. The pattern reported during the TBARS test has previously been documented in studies on irradiated fish fillets and chicken breast meat containing oregano essential oil stored in refrigeration [33, 32]. This result may be due to the initial formation of malondialdehyde and its subsequent degradation in later stages. Additionally, the effect of barberry extract in delaying the increase in malondialdehyde levels is attributed to its high phenolic content, which enhances its antioxidant properties. The antioxidant power of phenolic compounds is due to their important role in adsorbing and neutralizing free radicals and removing singlet oxygen from reactions. Aliakbarlu et al. (2014) reported the very high antioxidant effects of barberry extract [34]. Treatments containing extracts, coatings, and essences significantly controlled the increase in fat oxidation ($P \leq 0.05$). Essential oils and plant extracts are rich sources of phenolic compounds and demonstrate a wide range of inhibitory effects in coatings [35]. The bioactive compounds in coatings serve as suitable carriers for food additives, including antioxidants and antimicrobial agents [37, 36]. Moradi et al. (2012) demonstrated the antioxidant and antimicrobial properties of chitosan coatings containing Shirazi thyme essential oil and grape seed extract in a type of sausage [38].

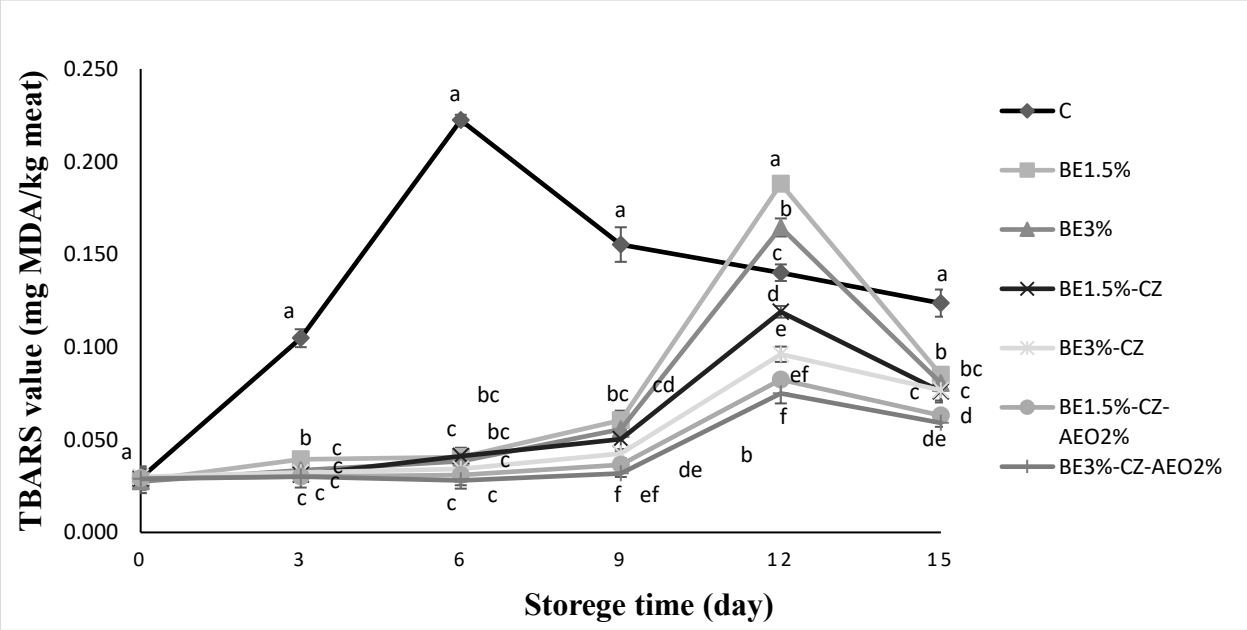

Fig 5 Changes in TBARS value (mg MDA/kg) of chicken breast meat during refrigerated storage. Non-identical letters indicate a significant difference in confidence level of 95%

3.3.4. Changes in sensory characteristics

Table 1 presents the results of sensory analysis (taste, color, texture, odor, and overall acceptability) of the studied samples during the storage period. Based on the obtained results, treatments containing extract, coating, and essence scored significantly higher in most cases compared to other treatments ($P \leq 0.05$). Regarding the color factor, the BE3%-CZ and BE1.5%-CZ treatments (Table 2) received the highest scores. The control treatment scored significantly lower in all sensory attributes (taste, color, texture, aroma, and overall acceptability) compared to all other treatments ($P \leq 0.05$). One of the significant sensory changes in meat during storage is the undesirable changes in color, aroma, texture, and taste, which occur due to the growth of microorganisms and chemical changes resulting from oxidation and the production of volatile compounds, leading to a reduction in its shelf life. The extent of these changes varies among different types of meat and based on various factors [16]. In the present study, the addition of barberry extract improved all sensory attributes of chicken breast meat compared to the control group. Barberry fruit, with its unique and palatable taste, low pH, presence of anthocyanin

pigments, and attractive color, can be used in the preparation of various products. Anthocyanins are effective absorbers of visible light and thus appear as colorants responsible for the orange, red, and blue colors of berry fruits such as strawberries, raspberries, barberries, and black and red seedless raisins [39]. The results showed that the combination of yellow zein color with red barberry extract color made the treatments containing these two components (BE1.5%-CZ, BE3%-CZ) more favorable among the evaluators. The addition of barberry extract significantly increased the odor score compared to the control group. Additionally, the incorporation of corn zein coating along with onion essential oil significantly improved this factor and made chicken breast meat more palatable ($P \leq 0.05$). This may be related to the presence of polyphenolic compounds in barberry fruit and essential oil, which contributed to the tenderness of the meat [40]. The results obtained regarding the overall acceptability of the various treatments in this study indicated that increasing the concentration of barberry extract alongside corn zein coating containing onion essence led to an increase in the overall acceptability of the treatments. The highest score for overall acceptability was related to the BE3%-CZ-AEO2% and BE1.5%-CZ-AEO2% treatments, while the lowest score for overall acceptability was attributed to the control treatment. Notably, the coated samples with onion essence and barberry extract received acceptable sensory scores for all factors. The results obtained in this study are consistent with the sensory results obtained by other researchers regarding chicken breast meat treated with pomegranate juice and chitosan coating containing Shirazi thyme essential oil, as well as chicken sausage containing barberry extract [40, 28].

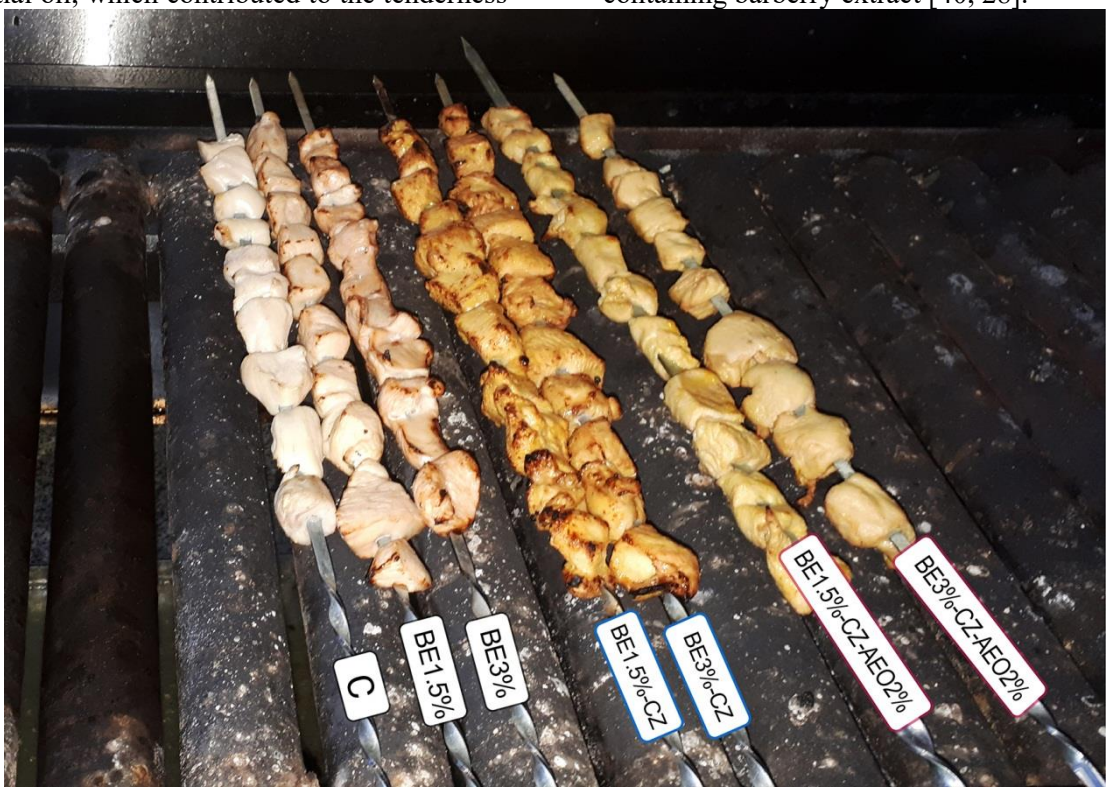

Fig 6 View of the grilled treatments.

Table 1 Changes in sensory attributes of chicken breast meat during refrigerated storage.

Sensory attributes			Treatments		
Overall acceptability	Odor	Texture	Color	Taste	
3.08±0.75 ^{e}	3.77±0.85 ^{e}	3.25±0.44 ^{e}	2.19±0.70 ^{e}	3.09±0.88 ^{g}	C

3.79±0.70 ^{d}	4.12±0.44 ^{d}	3.84±0.54 ^{d}	3.27±0.34 ^{d}	3.99±0.45 ^{f}	BE1.5%
3.86±0.55 ^{c}	4.15±0.56 ^{c}	3.90±0.80 ^{c}	3.47±0.56 ^{c}	3.93±0.51 ^{e}	BE3%
4.53±0.65 ^{b}	4.31±0.55 ^{b}	4.89±0.25 ^{b}	5.00±0.22 ^{a}	4.22±0.46 ^{d}	BE1.5%-CZ
4.53±0.71 ^{b}	4.33±0.50 ^{b}	4.90±0.50 ^{ab}	5.00±0.00 ^{a}	4.19±0.45 ^{c}	BE3%-CZ
4.82±0.25 ^{a}	4.99±0.45 ^{a}	4.92±0.45 ^{a}	4.78±0.25 ^{b}	4.42±0.74 ^{b}	BE1.5%-CZ-AEO2%
4.84±0.40 ^{a}	5.00±0.00 ^{a}	4.90±0.46 ^{ab}	4.80±0.00 ^{b}	4.54±0.55 ^{a}	BE3%-CZ-AEO2%

Non-identical letters indicate a significant difference in confidence level of 95%

4. Conclusion

According to the results obtained from this research, the ethanolic extract (50%) of barberry fruit obtained through the ultrasound method exhibited the highest inhibitory effect against DPPH and ABTS free radicals. Coating chicken breast meat in the barberry fruit extract significantly increased its shelf life and improved its sensory characteristics in a concentration-dependent manner during the storage period ($P \leq 0.05$). Additionally, coating with corn zein containing onion essential oil significantly enhanced the effects of the extract used ($P \leq 0.05$). Therefore, it can be concluded that the treatment BE3%-CZ-AEO2% was the most effective group in significantly increasing the shelf life of chicken breast meat underrefrigeration for 15 days due to its high antioxidant properties and the creation of desirable sensory characteristics ($P \leq 0.05$). The formulation used improved the organoleptic properties of the chicken breast samples, making them more palatable to evaluators. Coating the samples with corn zein enhanced the sensory effects, particularly the color factor. Based on the results obtained, it can be concluded that the edible coating of corn zein combined with barberry fruit extract (3%) and onion essential oil (2%) is the most effective formulation for extending the shelf life of meat food samples.

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مقاله علمی_پژوهشی

تاثیر پوشش خوراکی زئین ذرت حاوی عصاره میوه زرشک و اسانس پیاز بر افزایش ماندگاری اکسیداتیو گوشت سینهٔ مرغ

دعا موسوی پارسا[۱]، بهناز بازرگانی گیلانی[۲]*، محمدرضا پژوهی الموتی[۲]

۱- دانش آموخته کارشناسی ارشد گروه بهداشت و کنترل کیفی مواد غذایی دانشکده دامپزشکی دانشگاه بوعلی سینا همدان ایران.

۲- دانشیار گروه بهداشت و کنترل کیفی مواد غذایی دانشکده دامپزشکی دانشگاه بوعلی سینا همدان ایران.

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* مسئول مکاتبات:

behnazbazargani90@gmail.com
b.bazargani@basu.ac.ir

چکیده

این مطالعه به منظور بررسی تاثیر عصارهٔ زرشک (BE) و پوشش خوراکی زئین ذرت (CZ) غنی شده با اسانس پیاز *(Allium cepa)* (AEO) بر ماندگاری و خصوصیات حسی گوشت سینه مرغ انجام شد. عصاره اتانولی زرشک به طور معنی داری نسبت به سایر عصاره ها، بالاترین خاصیت آنتی اکسیدانی را دارد (P≤۰/۰۵). تیمارهای مورد مطالعه شامل: نمونه های غوطه ور در آب مقطر استریل به عنوان گروه کنترل(C)، نمونه های غوطه ور در عصارهٔ زرشک ۱/۵٪ (BE1.5%)، نمونه های غوطه ور در عصارهٔ زرشک ۳٪ (BE3%)، نمونه های غوطه ور در عصارهٔ زرشک ۱/۵ ٪ و زئین ذرت (BE1.5%-CZ)، نمونه های غوطه ور در عصارهٔ زرشک ۳٪ و زئین ذرت (BE3%-CZ)، نمونه های غوطه ور در عصارهٔ زرشک ۱/۵٪ و زئین ذرت غنی شده با اسانس پیاز ۲٪ (BE1.5%-CZ-AEO2%) و نمونه های غوطه ور در عصارهٔ زرشک ۳٪ و زئین ذرت غنی شده با اسانس پیاز ۲٪ (BE3%-CZ-AEO2%) بودند. سپس نمونه های پوشش داده شده در دمای ۴±۱ C° قرار داده شدند و در فواصل ۳ روز به مدت ۱۵ روز از لحاظ شیمیایی و حسی مورد ارزیابی قرار گرفتند. مقدار PV (عدد پراکسید)، TBARS (تیوباربیتوریک اسید) و pH به طور معنی داری در تمامی تیمارها در مقایسه با گروه کنترل پایین تر بود (P≤۰/۰۵). ارزیابی حسی نشان داد که عصاره زرشک یک اثر ذائقه پسند و خوشایند بر تمام ویژگی های حسی گوشت سینهٔ مرغ نظیر طعم، رنگ، بافت، بو و مقبولیت کلی داشت. تیمار BE3%-CZ-AEO2% موثرترین گروه در افزایش ماندگاری نمونه ها بود و تیمارهای BE1.5%-CZ-AEO2%، BE1.5%-CZ، BE3% و BE1.5% به ترتیب در رده های بعدی قرار گرفتند. از این مطالعه نتیجه‌گیری می‌شود که عصارهٔ زرشک به همراه پوشش زئین ذرت حاوی اسانس پیاز می‌تواند به عنوان یک جانشین مناسب برای نگهدارنده‌ها و طعم دهنده‌های شیمیایی در گوشت سینه مرغ در شرایط یخچال معرفی شود.