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EFFECT OF ALKALINE AND ACIDIC ELECTROLYZED WATER ON SHELF LIFE OF CHICKEN BREAST FILLETS DURING REFRIGERATION STORAGE

EL ASUOTY, M.S.[1]; GADALLA, A.M.[2]; GAMAL A. M. OMRAN [3]; NEVEEN M. M. ABDELMOTILIB [4] AND WALAA M. EL KASSAS [5]

[1] Senior Researcher. Animal Health Research Institute (AHRI)-Damanhur Branch, (Food Hygiene Unit)

[2] Researcher. Animal Health Research Institute (AHRI)-Damanhour Branch, (Bacteriology Unit).

[3] Researcher. Animal Health Research Institute (AHRI)-Sohag Branch, (Microbiology Unit).

[4] Researcher of Food Safety Food Technology Department, Institute of Arid Lands Cultivation Research (ALCRI), City of Scientific Research and Technological Application (SRTA-City). Alex. Egypt

[5] Senior Researcher. Animal Health Research Institute (AHRI) -Kafrelsheikh branch, (Food Hygiene Unit)

[1,2,3,5] Agriculture Research Center (ARC), Egypt.

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ABSTRACT

The objective of this study was to evaluate the effects of slightly alkaline electrolyzed water (SAlEW) and slightly acidic electrolyzed water (SAcEW) on the sensory characteristics, chemical composition, and microbiological quality of fresh chilled chicken breast fillets that were submerged for five minutes and stored for 12 days at 4±1°C. The treated samples were contrasted with the untreated (control) samples, which according to the acceptable limits of (ES 1651/2005) had an APC count of 4.97±0.27 and a shelf-life of fewer than five days. The results showed that the chilled chicken fillet treated with SAlEW and SAcEW had a longer shelf life and could be consumed for up to seven and nine days, respectively, where APC was 4.75±0.18 and 4.57±0.02, the *E. coli* count was 1.82±0.52 and 1.65±0.17, the *Staph. aureus* count was 1.64±0.07 and 1.53±0.25, and the mold and yeast counts were 3.01±0.05 and 3.28±0.02, log10cfu/g, respectively. The pH values were 6.16±0.02 and 6.21±0.02, TBARS values were 0.84±0.01 and 0.77±0.02, and TVB-N values were 18.78±0.06 and 18.26±0.57, respectively according to the chemical analysis findings. Furthermore, marinating chicken fillet in combination of SAlEW and then SAcEW extended the shelf-life until the 12th day of storage, recorded APC 4.28±0.14, *E. coli* count 1.53±0.04 and *Staph.aureus* count 1.42±0.23, mold and yeast count 2.94±0.01 log10cfu/g, with pH value of 6.11±0.05,TBARS value of 0.67±0.03 and TVB-N value was 16.65±0.07. In conclusion, applying SAlEW and then SAcEW had a significantly decontaminating impact on microbial populations and extended the shelf-life of the chicken breast fillets under examination. All treatments worked well to lower the chemical values (pH, TBARS, and TVB-N), however the combination treatment produced the lowest values overall. Using the combination treatment improved the sensory quality of chicken fillets compared to other treated and untreated samples. As electrolyzed water a safe antimicrobial preservative for chilled chicken fillets, it is a potential technique to increase the shelf life and quality of chicken meat without leaving dangerous residues.

Keywords: Chicken Breast Fillets, Quality and Shelf life, Slightly Alkaline Electrolyzed Water, Slightly Acidic Electrolyzed Water

Corresponding author: El Asuoty, M.S.
E-mail address: drmohamedelasuity@yahoo.com
Present address: Senior Researcher. Animal Health Research Institute (AHRI)-Damanhur Branch, (Food Hygiene Unit), Agriculture Research Center (ARC), Egypt.

INTRODUCTION

Chicken is one of the most widely consumed types of poultry meat worldwide (Chouliara *et al.,* 2007). Owing to its high perishability, it is crucial to guarantee that goods containing chicken meat are free from microbiological contamination while being stored and marketed (Hong *et al.*, 2008a,b). Due to its verified uses in the food business, electrolyzed water (EW), an antimicrobial treatment technique, has been utilized as a disinfectant and sanitizing agent in the food industries of the United States and Japan. It has attracted attention recently. Additionally, it has been shown that the food and equipment surfaces are more affected by the activity of EW in the suspensions (Huang *et al.*, 2008; Attia *et al.*, 2021). The effectiveness of three different forms of electrolyzed water acidic, neutral, and alkaline as antibacterial agents in biological systems is now being studied (Al-Haq *et al.*, 2005).

In addition to being used as a cleaning agent to remove oily and organic debris from surfaces, slightly alkaline electrolyzed water (SAlEW) also seems to have antibacterial properties. On the other hand, food and surfaces in contact with food are sanitized by slightly acidic electrolyzed water or SAcEW. According to Tolba *et al.* (2023), the use of SAlEW and SAcEW together significantly reduced contamination and extended the shelf life of the fish under examination. Standard chemical sanitizers may leave behind hazardous residues that pose a health risk to people when applied to food and surfaces that come into touch with them. Owing to their great effectiveness and lack of hazardous residues, slightly alkaline electrolyzed water (SAlEW) and slightly acidic electrolyzed water (SAcEW) are now recognized as cutting-edge detergent and sanitizing agents for cleaning and decontaminating food, utensils, tools, surfaces, and equipment. After a salt solution typically NaCl (2g/L) is electrolyzed, water yielded is obtained. Two types of water are produced when electricity passes through the solution: slightly acidic electrolyzed water (SAcEW), also known as electrolyzed oxidized water (EOW) and containing hypochlorous acid (pH 5.4-6.5) at the anode, and slightly alkaline electrolyzed water (SAlEW), also known as electrolyzed reduced water (ERW), containing sodium hydroxide (NaCl, pH 8–10) at the cathode (Fukuzaki *et al.*, 2004). Furthermore, it has been documented that SAcEW exhibits potent antibacterial action at pH levels of 6.0–6.5. We hypothesized that SAcEW may be utilized as a sanitizing agent on poultry products without having any negative effects (Cao *et al.*, 2009; Rahman *et al.*, 2010a, 2010b).

According to Federico *et al.* (2021), alkaline electrolyzed water (AEW) was more effective against *Salmonella* and *E. coli* than it was against *Staph. aureus* and *Listeria* sp. Huda *et al.* (2022) examine the potent sanitizing and detergent effects of slightly alkaline electrolyzed water (SAlEW) and slightly acidic electrolyzed water (SAcEW), both separately and in combination, on chilled chicken fillets that were refrigerated at 4±1°C after a 5-minute dipping treatment. According to their studies, every treatment effectively decreased the number of microorganisms during storage, with the combination treatment exhibiting the best antimicrobial effectiveness. Thus, EW can be utilized to effectively eradicate or at the very least bring bacterial infection down to an acceptable level. Thus, this study aimed to ascertain how SAlEW and SAcEW, individually and in combination, affected the fresh chicken fillet meat's shelf life, sensory appeal, chemical composition, and microbiological quality after 12 days of storage at 4±1ºC.

MATERIALS AND METHODS

1. Collection and preparation of samples (Huda *et al.*, 2022)

The experiment was carried out in the Damanhour lab of the Animal Health

Research Institute. Four kilograms of fresh, raw, boneless chicken breast fillet samples were collected from poultry abattoirs in the province of El Behera, which is close to Damanhour city. The samples were then safely transported to the laboratory in sterile polyethylene bags. In an hour, they will be stored in different boxes with cooling packs and kept at 4±1ºC until they are required for this study. The samples, each weighing one kilogram, were divided into four groups. First, a control group was created and washed with sterile distilled water. Next, two groups were created and rinsed with slightly alkaline electrolyzed water (SAlEW), and slightly acidic electrolyzed water (SAcEW), and finally, a combination group was established and rinsed with SAlEW and then SAcEW for five minutes each.

2. The following steps should be taken to prepare electrolyzed water according to Al-Haq *et al.* (2005), Hricova *et al.* (2008), Athayde *et al.* (2018), and Tolba *et al.* (2023):

By electrolyzing tap water with sodium chloride (NaCl) 0.2% (2 g for every liter of tap water) using electrical water treatment device (alkaline and acid water ionizer machine AG7.0), electrolyzed water (EW) of both SAlEW (pH, 8.5) and SAcEW (pH, 6) was produced. For 10 minutes, an electrolysis chamber with two poles—the cathode (-) and anode (+) was subjected to a current of 9–10 volts and 8–10 amber. Ions were exchanged over a bridge between two different sides. The formation of hypochlorous acid (HOCl), hypochlorite ions (OCl-), and chlorine gas (Cl2) at the anode side resulted in the formation of SAcEW. On the cathode side, sodium hydroxide (NaOH) production led to the formation of SAlEW. A digital meter was used to assess the pH of EW (FSSAI, 2015).The principal products in the cathode are sodium hydroxide (NaOH) and dissolved H2, while the principal products in the anode are hydrochloric acid (HCl), hypochlorous (HOCl), and Cl2 dissolved. Because of Cl2 (and HOCl) and NaOH, respectively, the anode produces water with sanitizing qualities whereas the cathode produces water with cleaning qualities.

3. Sensory evaluation (Moghassem Hamidi *et al.*, 2021)

Seven trained sensory panelists performed the sensory evaluation on days 0 till day 12 of storage. Every sample was assessed three times. A straightforward four-point scoring system was used to assess color, odor, and texture in accordance with the guideline table. The following formula was used to determine the sensory index.

$$SI = \frac{(2X\ C) + (2X\ O) + T}{5}$$

Where C stands for color, O for odor, T for texture, and SI for sensory index. Assessing the color, texture, and odor of chicken breast flesh to determine its sensory quality score.

Terms used to describe breast chicken fillet that are used to assess its sensory qualities

	Score			
Attributes	4 (Highest quality)	3 (Good quality)	2 (Fair quality)	1 (Poor quality)
Color	Pink(natural color)	Increased turbidity	A few color changes	Color changes completely (yellow-gray)
Odor	Good odor of fresh chicken	Loss of good odor	Bad odor	Obvious putrefaction odor
Texture	Tight and elastic	Decreased stiffness and elasticity	Soft texture with no elasticity	Loose texture

4. Chemical analysis:

On days 0, 3, 5, 7, 9 and 12 of the storage, the following chemical analyses of every treatment were performed:

4.1. pH measurement (ES 63-11/2006)

The pH was measured using a Digital Jenco 609 pH meter.

4.2. Measurement of Thiobarbituric acid reactive substance (TBARS) (ES 63-9/2006):

A ten-gram sample and forty-eight milliliters of distilled water were combined. Add two milliliters of 4% ammonium chloride (to raise the pH to 1.5) to the previously mentioned components, blend for two minutes, and let the mixture sit at room temperature for ten minutes. After being put into Kjeldal flasks, the mixture was rinsed with further 50 mL of distilled water, an antifoaming solution, and a few glass beads. After the flask was heated to 50 °C, the Kjeldal distillation apparatus was put together. Ten minutes after the boiling started, distillates were collected. A stopped glass tube was filled with the distillates (50 ml), which had been mixed. After adding 5 milliliters of TBA reagent (0.2883/100 milliliters of glacial acetic acid), the tube was sealed, shook, and left in a bath of boiling water for 35 minutes. Similar to the sample, a blank was made by mixing 5 mL of TBA reagent with 5 mL of distilled water, and it was handled the same way. The tube was heated and then allowed to cool for ten minutes under tap water. A section was moved to a curette, then using a spectrophotometer (Perkin Elmer, 2380, USA) set to read the sample's optical density (D) against the blank at a wavelength of 538 nm. When comparing the sample to the blank, the TBA value is equal to Dx7.8 D.

4.3. Measurement of total volatile basic nitrogen (TVB-N) according to (ES 63/10-2006).

Mix 10g sample with 100mL distilled water and rinse it into the distillation flask with 100mL distilled water; then add 2g magnesium oxide and defoaming agent. The mixture was distilled using a micro Kjeldahl distillation apparatus. Collect the distillate in 25 ml of 4% boric acid and 5 drops of Tashero indicator for 25 minutes. Titrate the solution with (0.1 M) HCl and calculate TVB-N.

5. Microbiological analysis:

5. 1.Preparation of serial dilutions (APHA, 1992)

First, samples of chicken breast meat were surface sterilized with a hot spatula. After that, a sterile scalpel and forceps were used to remove the cauterized areas. Lastly, 25 grams of meat sample were weighed and put into a sterile homogenizer flask that contained 225 milliliters of peptone water (0.1%) under aseptic circumstances. The contents of each flask were homogenized at 14000 rpm for 2.5 minutes in order to yield a 10^{-1} dilution. After that, a sterile pipette was used to transfer 1 ml to a sterile test tube containing 9 ml of (0.1%) peptone water. Subsequently, a decimal serial dilution was made in increments of 10-10 to accommodate the entire range of anticipated sample contamination. For microbiological counting, the number of colonies in colony forming units per gram (cfu/g) of meat samples was counted and recorded.

5.2. Total aerobic plate count (APC): according to APHA (2001)

For the purpose of counting (APC), one milliliter of the appropriate diluent was plated in triplicate using the pour-plate technique on the plate count agar (Merck, Germany). After that, the plates were incubated for 48 hours at 37ºC.

5.3. *E. coli* count: (FDA, 2001)

Duplicate plates of Eosin methylene blue (EMB) agar (OXOID, CM0 069) were equally spread with 100 µl of each previously made serial dilution using a sterile bent glass spreader. At 37 °C, the inoculation plates were incubated for a full day (24hr). The greenish metallic colonies that were suspected of being *E. coli* had a dark purple center. The number of colonies and their expression as log CFU/g of material were recorded.

5.4. *Staphylococcus aureus* count:
According to (FDA, 2001) the serial dilution was distributed on egg yolk tellurite emulsion plates at 35ºC for 48 hours. Colonies that looked suspicious black, glossy, with a halo zone surrounding them were selected for morphological analysis and biochemical identification.

5.5. Counting mold and yeast by ISO 21527/1 (2008)
Each dilution was applied in increments of 0.2 ml onto Sabaroud Dextrose Agar (SDA) plates using a sterilized glass spreader. Following a 5-to 7-day incubation period at 25ºC±1ºC, counts were recorded as log10cfu/g of material.

6. Statistical analysis:
Three duplicate samples (n = 3) were analyzed for each attribute. The results were described using the mean and the standard error (SE) of the mean. One Way ANOVA was used to compare the means using SPSS software version 17.0, followed by Duncan's Multiple Range Test (Duncan, 1955). The data is shown as the mean ± SE of three replicates. P values <0.05were showed statistically significant.

RESULTS

Table 1: The mean scores for the sensory attributes of samples of chicken breast fillets stored at 4±1ºC for 12 days while being treated with varying amounts of slightly alkaline (SAlEW) and slightly acidic (SAcEW) electrolyzed water (Individually and in combination).

Parameter	Control	slightly alkaline (SAlEW)	slightly acidic (SAcEW)	(combination) (SAlEW) +(SAcEW)
Odor				
Day 0	3.65±0.03[a]	3.74±0.02[a]	3.89±0.23[a]	4.00±0.01[a]
Day 3	2.10±0.20[c]	2.42±0.03[b]	2.65±0.47[b]	3.35±0.25[a]
Day 5	1.95±0.45[c]	2.09±0.22[b]	2.25±0.37[b]	3.02±0.63[a]
Day 7	1.62±0.03[c]	1.74±0.02[b]	1.83±0.44[b]	2.53±0.01[a]
Day 9	1.56±0.09[d]	1.65±0.07[c]	1.74±0.02[b]	2.01±0.05[a]
Day 12	1.00±0.01[d]	1.45±0.02[c]	1.63±0.45[b]	1.95±0.02[a]
Color				
Day 0	3.72±0.01[a]	3.79±0.05[a]	3.90±0.02[a]	4.00±0.03[a]
Day 3	2.25±0.20[c]	2.54±0.09[b]	2.68±0.23[b]	3.59±0.34[a]
Day 5	1.97±0.62[c]	2.35±0.57[b]	2.42±0.22[b]	3.00±0.25[a]
Day 7	1.75±0.05[c]	1.89±0.02[b]	1.97±0.05[b]	2.52±0.24[a]
Day 9	1.52±0.37[d]	1.74±0.28[c]	1.82±0.95[b]	2.01±0.25[a]
Day 12	1.00±0.02[c]	1.63±0.52[b]	1.79±0.24[b]	1.97±0.34[a]
Texture				
Day 0	3.75±0.25[b]	3.82±0.45[a]	3.92±0.04[a]	4.00±0.05[a]
Day 3	2.32±0.33[c]	2.67±0.21[b]	2.75±0.09[b]	3.62±0.22[a]
Day 5	1.95±0.05[c]	2.40±0.08[b]	2.57±0.03[b]	3.25±0.07[a]
Day 7	1.83±0.07[c]	1.96±0.05[b]	1.99±0.25[b]	2.76±0.47[a]
Day 9	1.64±0.02[d]	1.74±0.03[c]	1.86±0.05[b]	2.13±0.58[a]
Day 12	1.00±0.07[d]	1.65±0.03[c]	1.77±0.62[b]	1.98±0.05[a]

Data expressed as mean ± SE of 3 replicates.
Values with different letters within the same row differed significantly at (P<0.05).

Table 2: Pattern of pH of chicken breast fillets samples stored at 4±1ºC for 12 days while being treated with varying amounts of slightly alkaline (SAlEW) and slightly acidic (SAcEW) electrolyzed water (Individually and in combination).

Storage days/ groups	pH values ±SE					
	Zero day	**3rd day**	**5th day**	**7th day**	**9th day**	**12th day**
Control	5.46±0.02[a]	5.97±0.45[a]	6.17±0.01[a]	6.27±0.02[a]	6.45±0.05[a]	6.47±0.04[a]
slightly alkaline (SAlEW)	5.47±0.04[a]	5.95±0.03[a]	5.99±0.05[a]	6.16±0.02[b]	6.37±03[b]	6.42±0.07[a]
slightly acidic (SAcEW)	5.45±0.03[a]	5.93±0.02[b]	5.95±0.01[b]	6.10±0.03[b]	6.21±0.02[c]	6.31±0.01[b]
(combinatio n)(SAlEW) +(SAcEW)	5.44±0.03[a]	5.92±0.06[b]	5.94±0.06[b]	5.97±0.01[c]	6.09±0.02[d]	6.11±0.05[c]

Data expressed as mean ± SE of 3 replicates.
Values with different letters within the same column differed significantly at (P<0.05).

Table 3: The TBARS values (mg/kg) of chicken breast fillets samples stored at 4±1ºC for 12 days while being treated with varying amounts of slightly alkaline (SAlEW) and slightly acidic (SAcEW) electrolyzed water (Individually and in combination).

Storage days/ groups	TBARS (Malonaldehyde mg /Kg) ±SE					
	Zero day	3rd day	5th day	7th day	9th day	12th day
Control	0.45±0.04[a]	0.67±0.02[a]	0.84±0.07[a]	1.25±0.02[a]	1.55±0.03[a]	1.98±0.04[a]
slightly alkaline (SAlEW)	0.43±0.01[a]	0.55±0.01[b]	0.71±0.01[b]	0.84±0.01[b]	1.02±0.02[b]	1.05±0.05[b]
slightly acidic (SAcEW)	0.42±0.02[a]	0.46±0.02[b]	0.63±0.04[b]	0.72±0.03[b]	0.77±0.02[c]	0.95±0.01[b]
(combination) (SAlEW) +(SAcEW)	0.41±0.03[a]	0.44±0.03[b]	0.48±0.09[c]	0.52±0.02[c]	0.57±0.05[d]	0.67±0.03[c]

Data expressed as mean ± SE of 3 replicates.
Values with different letters within the same column differed significantly at (P<0.05).

Table 4: Pattern of TVBN values (mg/100g) of chicken breast fillets samples stored at 4±1ºC for 12 days while being treated with varying amounts of slightly alkaline (SAlEW) and slightly acidic (SAcEW) electrolyzed water (Individually and in combination).

Storage days/ groups	TVBN values (mg/100 g meat) ±SE					
	Zero day	**3rd day**	**5th day**	**7th day**	**9th day**	**12th day**
Control	6.41±0.11[a]	13.15±0.25[a]	17.13±0.01[a]	21.25±0.71[a]	22.54±0.23[a]	23.45±0.01[a]
slightly alkaline (SAlEW)	6.35±0.25[a]	11.54±0.12[b]	15.29±0.45[b]	18.78±0.06[b]	20.54±0.05[a]	21.42±0.11[a]
slightly acidic (SAcEW)	6.32±0.22[a]	10.21±0.05[b]	13.81±0.22[b]	14.85±0.11[c]	18.26±0.57[b]	20.51±0.25[a]
(combination) (SAlEW) +(SAcEW)	6.23±0.12[a]	9.45±0.27[b]	11.35±0.02[c]	12.32±0.02[c]	13.09±0.25[c]	16.65±0.07[b]

Data expressed as mean ± SE of 3 replicates.
Values with different letters within the same column differed significantly at (P<0.05).

Table 5: Pattern of aerobic bacterial count APC (log10cfu/g) in chicken breast fillets samples stored at 4±1ºC for 12 days while being treated with varying amounts of slightly alkaline (SAlEW) and slightly acidic (SAcEW) electrolyzed water (Individually and in combination).
Data expressed as mean ± SE of 3 replicates.

Storage days/ groups	Total aerobic plate count (APC, log_{10}cfu/g)					
	Zero day	3rd day	5th day	7th day	9th day	12th day
Control	3.27±0.23[a]	4.82±0.36[a]	4.97±0.27[a]	5.85±0.23[a]	6.75±0.45[a]	7.54±0.11[a]
slightly alkaline (SAlEW)	3.16±0.01[a]	3.75±0.15[b]	4.33±0.22[b]	4.75±0.18[b]	5.02±0.36[b]	5.12±0.03[b]
slightly acidic (SAcEW)	3.14±0.35[a]	3.65±0.04[b]	4.15±0.36[b]	4.45±0.09[c]	4.57±0.02[c]	5.03±0.09[b]
(combination) (SAlEW) +(SAcEW)	3.05±0.45[a]	3.17±0.14[b]	3.43±0.45[c]	3.89±0.20[d]	4.05±0.27[d]	4.28±0.14[c]

Values with different letters within the same column differed significantly at (P<0.05).

Table 6: Pattern of *E.coli* count (log10cfu/g) in chicken breast fillets samples stored at 4±1ºC for 12 days while being treated with varying amounts of slightly alkaline (SAlEW) and slightly acidic (SAcEW) electrolyzed water (Individually and in combination).
Data expressed as mean ± SE of 3 replicates.

Storage days/ groups	Total *E. coli* count (log_{10}cfu/g)					
	Zero day	3rd day	5th day	7th day	9th day	12th day
Control	1.75±0.25[a]	1.86±0.45[a]	1.97±0.07[a]	2.23±0.14[a]	2.32±0.15[a]	2.52±0.15[a]
slightly alkaline (SAlEW)	1.41±0.37[a]	1.64±0.85[a]	1.75±0.13[b]	1.82±0.52[b]	1.87±0.14[b]	2.11±0.14[b]
slightly acidic (SAcEW)	1.25±0.05[a]	1.45±0.11[b]	1.52±0.12[c]	1.59±0.35[c]	1.65±0.17[c]	1.89±0.25[c]
(combination) (SAlEW) +(SAcEW)	1.18±0.01[a]	1.23±0.15[b]	1.34±0.13[c]	1.38±0.16[c]	1.47±0.13[c]	1.53±0.04[d]

Values with different letters within the same column differed significantly at (P<0.05).

Table 7: Pattern of *Staph. aureus* count (log10cfu/g) in chicken breast fillets samples stored at 4±1ºC for 12 days while being treated with varying amounts of slightly alkaline (SAlEW) and slightly acidic (SAcEW) electrolyzed water (Individually and in combination).

Storage days/ groups	Total *Staph. aureus* count(log_{10}cfu/g)					
	Zero day	3rd day	5th day	7th day	9th day	12th day
Control	1.25±0.03[a]	1.43±0.05[a]	1.67±0.05[a]	2.72±0.25[a]	2.82±0.36[a]	2.85±0.35[a]
slightly alkaline (SAlEW)	1.21±0.25[a]	1.31±0.27[a]	1.52±0.33[b]	1.64±0.07[b]	1.74±0.05[b]	2.12±0.10[b]
slightly acidic (SAcEW)	1.13±0.46[a]	1.24±0.03[a]	1.35±0.05[b]	1.42±0.09[c]	1.53±0.25[c]	1.77±0.05[c]
(combination) (SAlEW) +(SAcEW)	1.02±0.32[a]	1.11±0.10[b]	1.24±0.02[b]	1.32±0.06[c]	1.38±0.02[c]	1.42±0.23[d]

Data expressed as mean ± SE of 3 replicates.
Values with different letters within the same column differed significantly at (P<0.05).

Table 8: Pattern of mold and yeast count (log10cfu/g) in chicken breast fillets samples stored at 4±1ºC for 12 days while being treated with varying amounts of slightly alkaline (SAlEW) and slightly acidic (SAcEW) electrolyzed water (Individually and in combination).

Storage days/ groups	Total mold and yeast count (log_{10}cfu/g)					
	Zero day	3rd day	5th day	7th day	9th day	12th day
Control	2.25±0.35 ^{a}	2.74±0.25^{a}	3.23±0.06^{a}	4.37±0.02^{a}	4.86±0.07^{a}	5.09±0.01^{a}
slightly alkaline (SAlEW)	2.19±0.78 ^{a}	2.52±0.01^{b}	2.63±0.03^{b}	3.01±0.05^{b}	3.75±0.04^{b}	4.11±0.02^{b}
slightly acidic (SAcEW)	2.11±0.09^{a}	2.25±0.47^{b}	2.37±0.02^{b}	2.82±0.09^{b}	3.28±0.02^{c}	3.47±0.25^{c}
(combination) (SAlEW) +(SAcEW)	1.95±0.02 ^{a}	2.09±0.11^{c}	2.18±0.25^{c}	2.32±0.34^{c}	2.45±0.03^{d}	2.94±0.01^{d}

Data expressed as mean ± SE of 3 replicates.
Values with different letters within the same column differed significantly at (P<0.05).

DISCUSSION

1. Sensory evaluation:

According to Zheng *et al.* (2019), the sensory evaluation was based on several sensory features, such as color, texture, and odor. A sensory profile enables us to assess food quality and, eventually, spot undesirable substances (Rasooli, 2007). **Table (1)** shows the sensory analysis results conducted on the treated chicken breast meat samples from days 0 to 12 of storage. The panelists found that the freshly prepared chicken breast samples (day 0) in both the untreated and treated samples with slightly alkaline electrolyzed water (SAlEW) and slightly acidic (SAcEW) (individually and in combination) were well in all sensory qualities. The odor, color, and texture sensory indices of each treatment decreased over storage and the control group had the lowest score at the end of storage (day 12).

The chicken breast samples treated with slightly acidic (SAcEW) and slightly alkaline (SAlEW) electrolyzed water (both alone and together) outperformed the control samples in every sensory category. Up until the end of the sixth storage day, there was a discernible improvement in the appearance, softness, and flavour of the chicken breast meat when using slightly acidic (SAcEW) and slightly alkaline electrolyzed water (SAlEW), both separately and in combination. The chicken breast samples, especially the control sample, showed a significant loss in sensory quality after five days of storage, rendering them unfit for cooking. Sensory attribute alterations were significantly difference (P<0.05) in chicken breast samples treated with a combination of slightly acidic (SAcEW) and slightly alkaline (SAlEW) electrolyzed water when compared to control samples and other treatment groups. So, this combination is thought to be the best group for improving the sensory quality and shelf life of chicken breast fillets when compared with other treated and untreated groups.

These findings are in line with those of Huda *et al.* (2022), who found that all treatments involving electrolyzed water that was slightly alkaline (SAlEW) and slightly acidic (SAcEW) were effective in reducing the number of microorganisms in chicken meat during storage, with the combined treatment having the greatest antimicrobial activity. The results in present study also concur with Tolba *et al.* (2023) who found that applying SAlEW and then SAcEW had a significant decontaminating impact and extended the fish's shelf life. The obtained results matched with Jung *et al.* (2018) who found that SAEW-ice affect positively the microbiological, chemical parameters and sensory characteristics of brown sole as compared with traditional water ice (TWice).

2. Chemical analysis of treated chicken meat:

2.1. Hydrogen ion concentration (pH)

The data collected and displayed in **Table (2)** demonstrated that the pH values of the control and treated samples with slightly acidic (SAcEW) and slightly alkaline (SAlEW) electrolyzed water (both separately and in combination) raised during the course of the storage period until the end of day 12. The initial pH of the chicken breast fillet samples in control group was 5.46±0.02 on zero-day, with a change in pH of that value. At 9th day of storage, there was a significant difference between the control and treated groups ($P<0.05$), where the combined treated group (SAlEW +SAcEW) had the best pH value. At the end of storage (day 12), the control group had the highest pH value (6.47±04), while the treated group with a combination ofSAlEW and SAcEW electrolyzed water had the lowest value (6.11±05). The individual values of the treated groups (SAlEW and SAcEW) were 6.42±07 and 6.31±01, respectively.

The beginning of spoiling was linked to meat's pH increasing as it was being stored. The generation of amines and the breakdown of proteins may be the cause of this pH rise during storage (Gill 1983). Throughout the refrigerator storage period, the chicken breast meat samples (control or treated groups) showed an increase in pH values due to lipid/protein degradation caused by chemicals, microbes, and physical damage. This may have been caused by the action of microbial or endogenous enzymes like lipase and protease, which raise the concentration of volatile bases over extended storage (Hernández Pimentel *et al.*, 2020).

Our findings are consistent with previous research, which found that beef products' pH value rose while they were being stored (Min *et al.*, 2003). Additionally, concur with Shimamura *et al.* (2016), who proposed that combining treatments with AlEW and StAEW might ameliorate the increase in pH and subsequent decrease in meat quality. In this study, combined therapy with AlEW and StAEW had similar effects. It was proposed that treating with AlEW may inhibit pH increases. Comparable outcomes were reported by Lin *et al.* (2013), who concluded that AlEW could be able to restrict the pH variations in prawn meat.

Furthermore, it was reported by Katayose *et al.* (2007) and Huang *et al.* (2008) that AlEW is a unique non-thermal bactericidal method with minimal negative effects on the environment and human body. Low pH (Liu *et al.*, 2006), high oxidation-reduction potential (ORP), and the production and combination of free chlorine are linked to AcEW's antibacterial action (Abbasi and Laza-rovitis, 2006 and Liao *et al.*, 2007). The collected information was in line with the findings of Wang *et al.* (2014), who reported that acidic electrolyzed water (AEW) ice was shown to be useful in delaying the rise in pH towards the alkaline side, which is indicated by the start of prawn degradation.

2.2. Thiobarbituric acid reactive substances (TBARs):

Lipid oxidation is an important factor of oxidative deterioration of food which can be measured by the content of TBA which acts as indicator of the degree of lipid oxidation of food (Campo *et al.*, 2006). The changes in the values of TBA of treated and untreated chicken breast fillets during storage are illustrated in **Table (3).**There was a tendency towards higher TBA content as storage times increased. The results showed that TBA values of the all groups increased gradually till the end of storage (day 12), the control group had the highest TBA value 1.98±0.04, while treated group with combination of slightly alkaline electrolyzed water (SAlEW) and slightly acidic (SAcEW) had the lowest value 0.67±0.03, whereas treated groups with slightly alkaline electrolyzed water (SAlEW) and slightly acidic (SAcEW) (individually) values were recorded 1.05±0.05 and 0.95±0.01 mg MDA/kg respectively. Compared to the control and other treated groups, the samples treated with combination of SAlEW and SAcEW were significantly difference at P<0.05 which had the lowest TBA value. Compared with (ES 1651/2005) which reported that, TBA in chicken meat shouldn't exceed 0.9 mg/kg of chicken meat, the obtained results showed that TBA values were within the permissible limits at the time which the samples were exceeded the microbiological limits. The samples in the control group are valid until day 5 only, while the samples treated with slightly alkaline electrolyzed water SAlEW are good for consumption until day 7; and those treated with slightly acidic electrolyzed water SAcEW are valid for consumption until day 9. While, the samples treated with combination of slightly alkaline electrolyzed water SAlEW and slightly acidic SAcEW within the permissible limit, it valid for consumption until day 12 and it consider the best group compared with other treated and untreated groups. TBA levels in treated samples dramatically lowered malondialdehyde (MDA) levels in comparison to the control sample,that exhibited modest levels of lipid oxidation, indicating no oxidative rancidity throughout the storage period. Similar findings supported by Shimamura *et al.* (2016) revealed that treating beef in conjunction with AlEW and StAEW can lessen its lipid oxidation. Tolba *et al.* (2023) have documented an increasing trend in TBA content with an increase in storage duration for all fish meat samples, supporting similar findings.

The TBA was substantially slower and suppressed through preservation of samples in combination of SAlEW-ice followed by SAcEW-ice or through using of SAlEW-ice, SAcEW individually as compared with samples preserved in ordinary drinking water (OW-ice) (Control). The main byproduct of oxidative rancidity, malondialdehyde (MDA), is what gives oxidized fat its foul flavor. Products made from chicken breast meat have low quantities of antioxidants and high levels of polyunsaturated fatty acids, which make them vulnerable to oxidative degradation (Dawson and Gartner, 1983).

2.3. Total Volatile Basic Nitrogen (TVB-N)

As a result of microbial activity, proteins and non-protein nitrogenous substances were degraded, resulting in total volatile base nitrogen (TVB-N). According to Tolba *et al.* (2023), TVB-N is thought to be a significant and accurate biomarker of meat freshness throughout storage. The TVB-N values of the samples during storage are displayed in **Table (4)**, which indicates that the mean ± standard error (SE) values of TVB-N of the examined control samples exhibit a higher rate of increase in TVN content. At the beginning of cold storage, the values were 6.41±0.11 mg/100 g, and after 12 days, they increased to 23.45±0.01 mg/100 g. Conversely, the samples of chicken breast treated with slightly alkaline (SAlEW) and slightly acidic (SAcEW) electrolyzed water (both separately and together) had the lowest TVB-N content from the start of cold storage (6.35±0.25, 6.32±0.22 and 6.23±0.12 mg/100 g) to the end of cold storage after 12 days (21.42±0.11, 20.51±0.25 and 16.65±0.07 mg/100 g), respectively. The beneficial effects of adding SAlEW and SAcEW electrolyzed water (both alone and together) may be related to the suppression of microorganisms and the prevention of protein breakdown that produces volatile nitrogen molecules.

The combination of SAlEW + SAcEW was differ significantly at P<0.05which consider the best group compared with other treated and untreated groups. The obtained findings indicated that TVB-N levels were within the permitted limits during the time the samples were exceeding the microbiological limits, in accordance with the permissible limits defined by ES/ 1651 (2005), which stipulated that TVN should not exceed 20 mg/100 g. The control group was deemed safe to consume until day five of storage, chicken flesh samples treated with slightly alkaline electrolyzed water (SAlEW) were safe to eat until day seven of storage, and chicken breast treated with slightly acidic SAcEW was safe to eat until day nine of storage. Even on day 12 of storage at 4^{o}C, treated chicken meat samples with combination of SAlEW + SAcEW do not surpass the allowable limit and are still suitable for human consumption.

The obtained results were matched with Tolba *et al.* (2023) who reported that the TVB-N values showed to be increased with storage time in all fish meat groups. The TVB-N was substantially slower and suppressed through preservation of samples in combination of SAlEW-ice followed by SAcEW-ice ($p < 0.001$) or through using of SAcEW alone ($p < 0.05$) as compared with samples preserved in OW-ice. Ammonia is caused by the breakdown of nitrogenous substances that are not proteins and are primarily produced by microbial activities. According to Veberg *et al.* (2006), TVB-N is thought to be a significant and accurate predictor of the freshness of meat throughout storage. The breakdown of protein caused by the activity of various bacteria and their proteolytic enzymes may be the source of the rise in TVB-N value in the meat (Hassan and Omama, 2011).

3. Microbiological analysis

3.1 Total aerobic plate count (APC):

Electrolyzed water is a potent multifunctional antibacterial agent. The slightly acidic electrolyzed water (SAcEW) has powerful sanitizing effect, while the slightly alkaline electrolyzed water (SAlEW) has detergent effect (individually), while in combination showing strongest antimicrobial activity on chilled chicken fillets. It is very important in agriculture and medicine, and it has several uses in food safety via processing and storage (Huda *et al.,* 2022). Elevated APC can be linked to many sources of contamination in chicken meat, inadequate processing, and improper storage conditions (Zahran, 2004). The information displayed in **Table (5)** demonstrated that the mean aerobic plate count values of the control samples varied from 3.27±0.23 log10 cfu/g on day zero to 7.54±0.11 log10 cfu/g on day twelve of storage. Treatment with slightly alkaline electrolyzed water (SAlEW), mean was ranged from 3.16±0.01to 5.12±0.03 log10 cfu/g at day zero and 12 of storage, respectively; at slightly acidic electrolyzed water (SAcEW), APC was ranged from 3.14±0.35 at day zero to 5.03±0.09 log10 cfu/g at day 12 of storage. Finally, at combination of SAlEW + SAcEW, aerobic plate count was ranged from 3.05±0.45 to 4.28±0.14 log10 cfu/g at day zero and 12 of storage, respectively. Samples treated with (SAlEW) and (SAcEW) (individually and in combination), displayed decreasing count of aerobic microorganisms especially with combination of SAlEW + SAcEW, which showing significantly decrease at $p < 0.05$ when compared with control group.

The overall bacterial count should not be more than 10^5/g, (ES 1651/2005). At day 5, APC count for the control samples was 4.97±0.27, which was almost at the maximum recommended limit, while at day 7 was 5.85±0.23 which was over the maximum recommended limit and indicated that the untreated control chicken breast samples had a shelf-life of less than 5 days. The treated samples exhibited a delayed growth for APC till day 12, and a larger decreasing impact in APC was noted in group treated with combination of SAlEW + SAcEW where it was within the permissible limit (4.28±0.14), this indicates that under chilled storage, the chicken fillets samples' shelf life was extended to 12 days. While the APC values for the samples of chicken meat treated with slightly acidic (SAcEW) electrolyzed water were suitable for eating until day nine of storage, while the samples treated with slightly alkaline (SAlEW) electrolyzed water remained valid until day seven of storage. These findings were in line with Huda *et al.* (2022), who stated that adding SAlEW and then SAcEW extended the shelf life of chicken fillets until the eleventh day of storage and decreased APC to4.94±0.01. Additionally, they found that the combination of SAlEW + SAcEW had the greatest antibacterial activity and was beneficial in lowering microbial populations. Similar findings have also been supported by Tolba *et al.* (2023) who reported that, using of SAlEW followed by SAcEW had a highly decontamination effect on both APC and total psychotropic count as well as prolong the shelf-life of examined fish, especially SAcEW which had a strong effect on reducing of both APC and total psychotropic count. These findings also corroborated the findings of Attia *et al.* (2021), and Federico *et al.* (2021), which reported that SAcEW was an effective way to prolong the shelf life of beef and chicken meat when compared to other treatments and Shimamura *et al.* (2016) reported that the combination treatment of SAlEW and SAcEW decreased the microbial counts.

The electrolyzed oxidizing water (EOW), which is a novel product obtained by electrolysis of water containing sodium chloride to yield primarily chlorine-based sanitizing products, is responsible for the bactericidal activity of slightly alkaline electrolyzed water (SAlEW) and slightly acidic electrolyzed water (SAcEW). Acidic pH causes the formation of hypochlorous acid, hypochlorite ions, and un-protonated chlorine gas, which has the highest potential for oxidation and sanitization and can break down microbial cell membranes by penetrating their walls. According to studies by Al-Haq *et al.* (2005), Huang *et al.* (2008), and Issa-Zacharia *et al.* (2010), EOW is a useful technique for lowering microbial contamination of food items and food contact surfaces. According to reports, the primary factor impacting SAEW's antimicrobial activity is its specific oxidation-reduction potential (ORP), which represents its capacity to oxidize or reduce (Al-Haq *et al.*, 2005). SAlEW and SAcEW are known as novel detergents and sanitizing agents for cleaning and decontamination of food, utensils, tools, surfaces and equipment's due to its high efficiency in microbial reduction and no harmful residues (Fukuzaki *et al.*, 2004).

3 .2 *E. coli* count

Since *E. coli* naturally exists in the digestive tracts of warm-blooded animals such as humans, its presence in chicken flesh is a reliable indicator of faecal contamination. Additionally, it suggests that gastrointestinal bacteria may have contaminated the area. Contamination of undercooked or raw chicken meat can occur during primary production, such as during slaughter, or subsequent processing and handling (Adeyanju and Ishola, 2014). The data shown in **Table (6)** indicate that the control sample's mean *E. coli* counts grew from 1.75±0.25 log10 cfu/g on day zero to 2.52±0.15 log10 cfu/g on day twelve of storage. The *E. coli* count was slightly elevated in chicken breast treated with SAlEW and SAcEW both separately and together (from 1.41±0.37 to 2.11±0.14 log10 cfu/g, from 1.25±0.05 to 1.89±0.25 log10 cfu/g and from 1.18±0.01 to 1.53±0.04 log10 cfu/g at day zero and 12 of storage), respectively.

Treatment with (SAlEW) and (SAcEW) (individually and in combination), produced significantly decrease in *E. coli* count when compared to control sample, especially group treated with combination of SAlEW + SAcEW, which showing significantly decrease at $p < 0.05$ when compared with other treated and untreated groups. Similarly, other researchers have reported that (SAlEW) and (SAcEW) (individually and in combination decreased *E. coli* count significantly in treated poultry meat by Fabrizio *et al.* (2002); Shimamura *et al.* (2016) and Huda *et al.*, (2022), *E. coli* populations were shown to diminish with combined treatment of SAlEW and SAcEW at 4°C.The bactericidal action of SAlEW and SAcEW (individually and in combination), against *E. coli* is attributed to its high hypochlorous (HOCl) content, which makes it more effective than hypochlorite (ClO −) at penetrating microbial cell walls and oxidatively attacking them (Veasey and Muriana 2016).

Strong bactericidal activities of SAEW against foodborne pathogens, such as *E. coli* O157:H7, *Vibrio parahaemolyticus*, *Listeria monocytogenes*, *Salmonella enteritidis*, *Staph. aureus*, and *Pseudomonas aeruginosa*, have been shown in previous studies (Cao *et al.*, 2009 and Issa-Zacharia *et al.*, 2010). The oxidation-reduction potential, or "ORP," of AEW has been shown by Liao *et al.* (2007) to damage *E. coli* O157:H7. According to Cao *et al.* (2009), SAEW demonstrates equivalent or more activity in bacteria when compared to AEW, sodium hypochlorite (NaOCl), and FCC at equivalent doses.

3.3. *Staph. aureus* count

The identification of *Staph. aureus* in chicken fillets suggests that food handlers and improperly maintained equipment may have contaminated the food (ICMSF, 1996). From results given in **Table (7)**, *Staph. aureus* count of control samples were increased from 1.25±0.03 at zero day to 2.85±0.35 log10 cfu/g at day 12 of storage. *Staph. aureus* count was 1.21±0.25, 1.13±0.46, and 1.02±0.32 log10 cfu/g for the treated samples (SAlEW and SAcEW), separately and in combination, at day zero, respectively. For every sample that was analyzed, the *Staph. aureus* count increased gradually on day twelve of storage. By day 12, *Staph. aureus* count was 2.12±0.10, 1.77±0.05 and 1.42±0.23 log10cfu/g for SAlEW and SAcEW (individually and in combination) treated samples, respectively, and treated samples containing SAlEW and SAcEW (singly and in combination) showed a considerably decreased *Staph. aureus* count ($P<0.05$) when refrigerated for the duration of the storage period, especially when in combination showed a more significant reduction. These findings are supported by Tolba *et al.* (2023) who reported that SAcEW alone or in combined with SAlEW had a highly reduction effect on *Staph. aureus*. Similar findings were reported by Shimamura *et al.* (2016), who reported that the initial populations of *S. Enteritidis*, *E. coli*, and *Staph. aureus* in chicken breast were significantly reduced by combination treatment with AlEW and StAEW.

Furthermore, Nan *et al.* (2010) found that treatment with slightly acidic electrolyzed water SAEW resulted in 100% inactivation of *Staph. aureus* and *E.coli*. Chlorine, which can influence bacteria by blocking carbohydrates metabolism enzymes. It is responsible for the bactericidal action of (SAlEW) and (SAcEW), both separately and in combination, against *Staph. aureus*, this prevented glucose oxidation (Eifert and Sanglay, 2002). AEW has been shown by Zeng *et al.* (2010) to modify membrane permeability, enhance conductivity, decrease intracellular ADN and potassium ions, and decrease *Staph. aureus* and *E.coli* dehydrogenase activity.

Staphylococcal enterotoxin A (SEA) was fragmented as a result of EW treatment, and thought to be denatured by EW treatment via an oxidative process involving reactive chlorine and hydroxyl radicals (Vinci and Antonelli 2002). EW might stop the synthesis of SEA in a broth used for brain heart infusion (Suzuki *et al.* 2002).

3.4. Mold and yeast count:

As seen by the data presented above in **Table (8)**, the mean values of mold and yeast counts in the control samples grew from 2.25±0.35 at zero days to 5.09±0.01log10 cfu/g on day 12 of storage. For chicken breast fillets that were treated with (SAlEW) and (SAcEW) (separately and in combination), the mold and yeast count increased slightly from 2.19±0.78 to 4.11±0.02 log10 cfu/g), from 2.11±0.09 to 3.47±0.25 log10 cfu/g and from 1.95±0.02 to 2.94±0.01 log10 cfu/g at day zero and twelve, respectively. Mold and yeast counts were considerably lower after treatment with SAlEW and SAcEW, both alone and in combination than in the control sample, especially with combination of SAlEW+SAcEW, which showing significantly decrease at $P<0.05$when compared with other treated and untreated groups. Similarly, other researchers have reported that (SAlEW) and (SAcEW) (individually and in combination) decreased mold and yeast count significantly in treated poultry meat by Huda *et al.* (2022), they also noted that samples' shelf life was extended by washing with SAlEW and then SAcEW; the samples recorded 3.88±0.03 on day 11 and were spoilt on day 12 (5.08±0.59). These findings also corroborated the findings of Xiong *et al.* (2014), and Lyu *et al.* (2018), who found a noteworthy reduction in the amount of mold in wheat grains and chicken flesh. Aflatoxin B1 content in peanuts is still lowered by AEW (Zhang *et al.,* 2012). Moreover, the data shown by Andrieli *et al.* (2020) and Lemos *et al.* (2020) showed that EW is not successful in lowering the count of molds, which is in contrast to the results obtained here.

CONCLUSION

The freshness of chicken breast fillets was shown to be substantially linked with the microbiological, chemical, and sensory properties. Based on the various analytical analyses of all the current findings, the chicken breast fillets stored in (SAlEW) and (SAcEW) (singly and together) were able to maintain the necessary safety and quality standards for 7, 9, and 12 days, respectively. The findings of this study also showed that the best way to increase the shelf life and enhance the quality of chicken breast fillets is to use SAlEW for five minutes at 4°C, followed by SAlEW for the same amount of time at the same temperature. This method can also be used as a preservation technique to enhance the safety and quality of chicken breast fillets.

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تأثير الماء القلوي والحامضي المحلل كهربائيا على فترة صلاحية صدور الدجاج أثناء الحفظ بالتبريد

محمد سعيد الاسيوطي ، أحمد محمد فايز جاد الله ، جمال عبد اللطيف محمد عمران ، نيفين منير عبد المطلب، ولاء محمد القصاص

Email: drmohamedelasuity@yahoo.com Assiut University web-site: www.aun.edu.eg

كان الهدف من هذه الدراسة هو تقييم تأثير الماء المحلل كهربائيا قليل القلوية (SAlEW) والماء المحلل كهربائيا قليل الحامضية (SAcEW) على الخصائص الحسية والتركيب الكيميائي والجودة الميكروبيولوجية لشرائح صدور الدجاج المبردة الطازجة التي تم غمرها لمدة خمس دقائق و يحفظ لمدة ١٢ يوم عند درجة حرارة ٤±١ درجة مئوية. تمت مقارنة العينات المعالجة مع العينات غير المعالجة (الضابطة) والتي حسب الحدود المقبولة للمواصفة (ES 1651/2005) كان العد البكتيري الكلي (APC) بها ٤,٩٧ ± ٠,٢٧ ومدة صلاحية أقل من خمسة أيام. وأظهرت النتائج أن شرائح الدجاج المبردة المعالجة بـ SAlEW وSAcEW تتمتع بفترة صلاحية أطول ويمكن استهلاكها لمدة تصل إلى سبعة وتسعة أيام، على التوالي، حيث كان العد البكتيري الكلي (APC) ٤,٧٥ ±٠,١٨ و ٤,٥٧ ± ٠,٠٢، وعدد الإشريكية القولونية (*E. coli*) ١,٨٢±٠,٥٢ و ١,٦٥ ± ٠,١٧، وعدد المكور العنقودي الذهبي (*Staph. aureus*) ١,٦٤± ٠,٠٧ و ١,٥٣ ± ٠,٢٥، والعفن والخميرة كانت الأعداد ٣,٠١ ± ٠,٠٥ و ٣,٢٨ ± ٠,٠٢(log10cfu / g)على التوالي. كانت قيم الأس الهيدروجيني ٦,١٦ ± ٠,٠٢ و ٦,٢١ ± ٠,٠٢، وكانت قيم حامض الثيوباربتيورك (TBARS) ٠,٨٤± ٠,٠١ و ٠,٧٧ ± ٠,٠٢، وكانت قيم النيتروجين الكلي المتطاير(TVB-N) ١٨,٧٨ ± ٠,٠٦ و ١٨,٢٦ ± ٠,٥٧على التوالي. علاوة على ذلك، أدى نقع شرائح الدجاج في خليط من الماء المحلل كهربائيًا ذو القلوية الطفيفة ثم الماء المحلل كهربائيًا ذو الحمضية الطفيفة إلى إطالة مدة الصلاحية حتى اليوم الثاني عشر من التخزين، وسجل العد البكتيري الكلي(APC) ٤,٢٨ ± ٠,١٤ ، وعدد الإشريكية القولونية ١,٥٣±٠,٠٤ وعدد المكور العنقودي الذهبي١,٤٢±٠,٢٣ وعدد العفن والخميرة ٢,٩٤ ± ٠,٠١ (log10cfu / g) على التوالي. و قيم الأس الهيدروجيني كانت ٦,١١±٠,٠٥ وقيم حامض الثيوباربتيورك (TBARS) كانت ٠,٦٧±٠,٠٣ وقيم النيتروجين الكلي المتطاير(TVN) كانت ١٦,٦٥±٠,٠٧. كان لتطبيق الماء المحلل كهربائيا قليل القلوية والماء المحلل كهربائيا قليل الحامضية تأثير كبير في تطهير الميكروبات وإطالة العمر الإفتراضي لشرائح صدور الدجاج قيد الفحص. عملت جميع المعالجات بشكل جيد لخفض القيم الكيميائية (الأس الهيدروجيني، حامض الثيوباربتيورك، والنيتروجين الكلي المتطاير) ولكن المعالجة المركبة أظهرت أدنى القيم بشكل عام، بالإضافة إلى تحسين الجودة الحسية مقارنة بالعينات الأخرى المعالجة أو غير المعالجة. نظرا لأن الماء المحلل كهربائيا هو مادة حافظة آمنة مضادة للميكروبات في شرائح الدجاج المبردة، فهي تقنية مقترحة لزيادة العمرالإفتراضي وجودة لحوم الدجاج دون ترك بقايا خطيرة.