The Chemical, Microbial and Sensory Characteristics of Refrigerated Chicken Breast Meat Treated with Sodium Lactate and Tri Sodium Citrate

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Received: 27/05/2017 Accepted: 19/09/2017

Abstract:
The current study aimed to use two types of organic acids, sodium lactate and tri sodium citrate, for the purpose of prolonging the storage life of the fresh chicken breast meat. Chicken samples were treated with different concentrations of these acids by spraying and immersing. The samples T1 and T3 were treated using sodium lactate 2% (dipping and spraying) respectively, while T4 and T5 treatments using sodium lactate 4% (immersing and spraying) respectively, T6 and T7 treatments using tri sodium citrate 1% (dipping and spraying) respectively, and T8 and T9 treatments using tri sodium citrate 2.5% (dipping and spraying) respectively. Each meat sample was treated with those organic acids for 10 minutes, then the samples were kept refrigerated at 4 ° C for different storage periods (0, 1, 3, 5, and 7) days. During storage time, chemical, microbial and sensory tests were conducted. On the seventh day of storage, treatment T1 recorded the highest PH value, while T6 and T9 gave the lowest PH values. During the same period, T9 and T7 recorded the lowest count of total bacteria, while T1 achieved the highest number of total bacteria. For psychrotroPHic, T4 performed less well than T1, T6, T8 and T9, which recorded the highest count of bacteria. In terms of sensory evaluation, there were non-significant differences between the studied traits except in color. The study concluded that sodium lactate and tri sodium citrate can be used to treat chicken breast meat to prolong its storage time in the fridge.

Key words: Sodium lactate, Tri sodium citrate, Chicken breast meat, Storage period.

Introduction:

Poultry now occupies the second rank in the world meat production, after pork. At the same time, the marketing of poultry has been greatly diversified with a significant increase in portions and processed products (Scheuermann, 2003). In addition to cheap prices compared to red meat, chicken meat has a high nutritional value, low cholesterol and saturated fatty acids level, which are the main reasons for

arteriosclerosis, and heart diseases due to the deposition in the blood vessels (FAO, 1992). Poultry meat pass many market channels starting with slaughtering process, bleeding (which is the starting point for microbial contamination), storage, marketing in shops, which lead to increasing the microbial load and lead to spoilage (Michael, 2000). The method to preserve poultry meat from deterioration is by keeping it in low temperature, it could be refrigerating for short period, while it can be frozen for several months (FSIS, 1995). Despite the hygiene measures applied during processes starting from slaughtering to packaging, pathogenic bacteria can gain access to the meat and proliferate. Shelf-life of refrigerated fresh muscle foods is determined mainly by microbiological and PHysical qualities during storage and handling (Chen and Shelef, 1992). Researchers have shown significant reduction of microbes on fresh meat carcass surfaces after the use of an acetic acid spray (Bacon *et al*., 1999; Cutter, 1999). The acetic acid is generally recognized as safe substance with no upper limit of daily intake for humans (FAO, 1965). Substantial increases in the occurrence of food poisoning outbreaks and commercial requirements to extend the safe, high quality shelf-life of food have focused attention on decontamination system (Islam *et al*., 2008; Canibe *et al*., 2001). Microbial contamination can reduce the quality of fresh meat, shorten its shelf- life and cause economic losses and health hazards. The use of chilling, freezing as well as organic acids and their salts have been investigated for the preservation of beef, lamb and other types of meat (Hudha *et al.,* 2010; Chueachuaychoo *et al.,* 2011; Perumalla *et al.,* 2012). In this study two different concentrations of sodium lactate and tri sodium citrate were used to treat chicken breast fillets via two methods, spraying and immersing, then to study PH, microbial content and sensory evaluation during different storage periods.

Material and methods:

A total of 15 broilers were collected from local market. Breasts were removed, deboned, skinned and stored (± 2 h) until treatment preparation was completed. Raw chicken breasts were cut into 100 gm pieces. Each treatment group consisted of pieces of raw chicken breast. Prepared raw chicken was maintained in the refrigerator at 4°C. After collection of samples, bacteriological analysis and sanitary quality determination were performed (0 day). Then each piece was randomly subjected to one of treatments: 1: Control (distilled water), 2: sodium lactate 2% by immersion, 3: sodium lactate 2% by spraying, 4: sodium lactate 4% by immersing, 5: sodium lactate 4% by spraying, 6: tri sodium citrate 1% by immersing, 7: tri sodium citrate 1% by spraying, 8: tri sodium citrate 2.5% by immersion, 9: tri sodium citrate 2.5% by spraying. All concentrations were mixed in a beaker and stirred for 5 min with aseptic techniques. Each treatment was replicated 4 times. After all treatments were prepared, the treatment solution was mixed with the raw breast for 10 min, then dried and kept at 4ºC refrigeration by wrapping with commercially available polyethylene bags. Then at 1st, 3rd , 5th and 7th days of storage, PH analysis, bacteriological analysis and organoleptic quality determination were performed.

PH measurement were done according to Naveena and Mendiratta, (2001).

Microbiological tests (Bacterial profile) (USDA/ FSIS, 1998) were measured aseptically, 25 ± 0.1 g of the sample had been weighted, transferred into a sterile blender jar, then 225 ml sterile PHosPHate buffer was added and blended at high speed for two minutes, to get 1:10 dilution. The foam was permitted to settle, and then 10 ml of the blended 1:10 dilution was pipetted into a 90 ml dilution

blank to make 1:100 dilutions. The procedure had been repeated to prepare serial dilutions of 10^{-3}, 10^{-4}, etc. All dilutions were shaken 25 times in a one-foot arc.

Total plate count: According to (AOAC 966.23 C, 1995).

PsychrotroPHic bacterial count: According to (APHA, 1992).

Sensory evaluation: The procedures of examinations were as per the recommendations of ISO (1995).

Statistical analysis: The XL Stat program for windows was used to study factors examined (treatments and periods) of the traits. Duncan multiple ranges used to compare the significancy between means ($p< 0.05$) (Steel *et al.*, 1996).

Results and Discussion:

PH values:

The Table (1) shows PH means values of fresh chicken breast meat for 9 treatments of the five storage periods. The results show that there were significant differences among the treatments in most periods of study, in the first day (0 days, before treatment) the highest PH value recorded in T8 (5.750), while the lowest mean value recorded was in T4, and T2 (5.450 ,5.450 respectively). In 1st day of study the highest mean values of PH recorded in T9 and T3 (5.650, 5.650 respectivel), while the lowest mean value recorded in T4 (4.950). In 3rd day of stprage there were no significant differences among all treatments. In 5th day of study the highest mean value of PH recorded in T1(5.900), and the lowest mean value recorded in T3 (5.500,). In 7th day of study the highest means value of PH recorded in T1 (7.150), while the lowest mean value recorded in T6 (5.525). In terms of storage period for each treatment, T7 showed the highest mean value of PH compared with 0, 1, 3 and 5 day of study, while the highest mean values was recorded in T8 in in the first day and 3rd of study, while for T9 the highest value recorded in 5th day of study. Table (1) show the differences among the fresh chicken breast meat before treated, these differences could be due to the stress factors before slaughtering, which resulted in less lactic acid formation (Berri, 2000), or bad handling of the chicken before slaughtering (Owens & Sam, 2000). The results of PH values of fresh breast meat agree with the studies of Qiao *et al*., (2002) and Wattanachant *et al*., (2004), which stated that the range of PH of poultry breast muscle was 5.766.10-, while PH values were lower than those recorded by Smith (2002), who stated that poultry meat breast muscle had PH of 5.84. Zhu *et al.,* (2009) demonstrated that SL helped to maintain stable PH during storage periods, and that this observation was possible due to its buffering capability. Acidity (PH values) of all samples slightly increased with the storage time ($P\leq0.05$).

An increase in PH may be attributed to the increase in volatile bases caused by bacterial activity (Cann *et al.,* 1983). Benjakul *et al.,* (2002) showed that the decomposition of nitrogenous compounds caused increase in PH. The uses of sodium lactate and tri sodium citrate causes decrease or blocked increase of PH values in treated meat. The low PH values of samples treated with sodium lactate and tri sodium citrate may have altered the growth of spoilage microorganisms, hence, extending the microbial shelf life of the product (Al-Sheddy *et al.,* 1999). Ali, (2010) recorded PH values in chicken carcasses stored at chilling conditions for 0 , 2 , 4 and 6 days as 6.00 , 6.21 , 6.80 and 7.20 respectively.

Table 1. Effect of sodium lactate and tri sodium citrate on PH value of chicken breast.

Treatment				Periods (day)				
				0	1st	3rd	5th	7th
Control			T1	5.550 bc B	5.350 cd B	5.550 a B	5.900 a B	7.150 a A
SL	2%	IM	T2	5.450 c BC	4.950 e C	5.700 a B	5.850 ab B	6.800 ab A
		SP	T3	5.550 bc B	5.650 a B	5.600 a B	5.500 c B	6.300 bcd A
	4%	IM	T4	5.450c C	4.950 e D	5.700 a B	5.600 bc BC	6.400 bc A
		SP	T5	5.550 bc B	5.450 bc B	5.500 a B	5.550 c B	6.650 ab A
SC	1%	IM	T6	5.650ab A	5.300 d C	5.500 a B	5.665 abc A	5.420 e A
		SP	T7	5.600 ab B	5.300 d C	5.500 a B	5.615 bc B	5.800 cde A
	2.5%	IM	T8	5.750 a A	5.575 ab B	5.750 a A	5.525 c B	5.650 de AB
		SP	T9	5.700ab A	5.650 a AB	5.450 a C	5.775 abc A	5.525 e BC

-Means have different lower-case at the same column and upper-case at the same row are significantly different at ($p < 0.05$).
IM: Immersion, SP: Spraying.

Total plate count:

The total plate counts mean values of fresh chicken breast meat storage for seven days under refrigeration are shown in Table (2). In the first day (before treated with organic acids), there were no significant differences among treatments. All treatments recorded TPC mean values within standard levels of Iraqi quality regulations fresh poultry meat (ICOSQC- IQS 2270/4, 2006) that specified the SPC of fresh poultry between 10^5- 10^7 CFU/g meat. In 1st day of experiment, there were significant differences among treatments, the lowest TPC mean values recorded in T1 (1.0×10^3 CFU/g meat), while the highest TPC mean values recorded in T3 (7.5×10^3 CFU/g meat). In 3rd day of experiment, results show there were significant differences among most of treatments, the lowest TPC mean values recorded in T3 and T5 (2.5×10^3 CFU/g meat), while the highest TPC mean value recorded in T6 (30.5×10^3 CFU/g meat). In 5th day of experiment, the lowest TPC mean value recorded in T3 (13.0×10^3 CFU/g meat), while the highest TPC mean value recorded in T1 (270.0×10^3 CFU/g meat). There were significant differences among treatments. In 7th day the lowest TPC mean value recorded in T9 (65.0×10^3 CFU/g meat), while the highest TPC mean values recorded in T1 (309.0×10^5 CFU/g meat), and T1, which differ significantly compared with the other treatments. All treatment except T1 recorded TPC mean values within standard levels of Iraqi quality regulations fresh poultry meat (ICOSQC- IQS 2270/4, 2006), when compared to the TPC mean values within same treatment at different periods of experiment (Table 2). The conclusion is that there were significant differences between treatments at the end of the experiment (7th day), and over the periods.

The 7th day recorded highest TPC mean value as compared to other periods of the experiment. The total microbial counts of food products not only reflect handling history, state of decomposition or degree of freshness, they may in some instances reflect the sanitary quality of the foods (Dickens *et al*., 1992). The determination of total viable bacteria effectively evaluates the hygienic quality of foods (Anower *et al*., 2004). Results of total plate counts at the first day (Table 2) show that there were no significant differences among treatments, and these may be related to that breast meat came from same sources. Study of Petrová *et al*., (2013) found that initial Total Viable Count (TVC) of chicken fillets of ca. 2.96 log CFU.g^{-1} (day 0), and indicates acceptable quality gave limit of acceptability for poultry products of 10^7 cfu.g^{-1}(Senter *et al.,* 2000). Mohizea *et al.* (1994) observed the initial total viable count ($\log_{10}$ cfu/cm^2), which ranged from log 3.8 to 5.5 with a mean of log 4.67. Pornaem *et al*., (2005) reported that spoilage of fresh poultry usually begins after 5 to 7 days of refrigerated storage, while, chicken produced by small facility is expected to be 35- days of storage. All treatments had TPC within standard levels of Iraqi quality regulations fresh poultry meat (10^6- 10^7 CFU/g) (ICOSQC- IQS 2270/4, 2006). After meat treatment with two types of organic acids (sodium lactate, and tri sodium citrate), results show there were significant reduction in TPC as compared to T1 (control), especially in T7 (SC 1% spraying), and T9 (SC 2.5% spraying), which recorded 78×10^3 and 65×10^3 CFU/g respectively. These counts indicated lower load than that of the control group, indicating the decontamination effect of the organic acid (Taher *et al.,* 2012*)*. Xiong *et al*., (1998) sprayed chicken skin with lactic acid in two concentrations; 1 and 2% for 30 second at room temperature, and determined 2.3 and 2.2 log reduction in total aerobic bacterial counts, as reported by Tosun and Tamer (2000) aerobic bacteria counts of chicken carcasses reduced by 1.259 and 2.502 log CFU per carcass after treatment with 1% and 3% lactic acid (4ºC) respectively. Significant reduction in the initial aerobic plate count had been also verified in chicken after dipping in lactic acid and tri sodium phosphate (Okolocha and Ellerbroek, 2005; Deumier, 2006; Del Río *et al.,* 2007). Lactic acid treatment has been also shown to result in increased shelf life of fresh poultry meat during refrigerated storage (Zeitoun and Debevere, 1992). Morshedy and Sallam (2009) recorded the total plate count in chicken carcasses stored at 4ºC for 0, 4, 6, days as 5.13, 6.87, 7.4 log 10 CFU/g meat respectively. Al-Rubaie *et al*., (2007) recorded that the standard plate count of broiler meat stored at 4°C for 0 , 3 , 6 days were 6.2 , 6.5, 6.8 log/ gm meat respectively. The highest total bacteria count was recorded in chicken breasts without skin (fillets), 4.22 ± 0.84 log10 cfu/g on day 1, 4.65 ± 0.74 log10 cfu/g on day 3, and 5.14 ± 0.86 log10 cfu/g on day 6 of storage (Kozačinski *et al*., 2012). The significant reduction of total plate count in breast meat treated with SC and SL may be related to lower PH values in this treatment and this noted by other researcher that the low PH value had an influence on bacterial growth (Jay *et al.,* 2005), may be similar to the observation of Francois (2004), who reported that the decontamination effect of a solution was very much correlated with the PH of that solution and the chicken meat and skin PH variation.

Table 2. Effect of sodium lactate and tri sodium citrate on Total plate count (CFU/g meat) of chicken breast

Treatment			Periods(day)					
			TREAT	0	1st	3rd	5th	7th
control			T1	3.5 × 10³a B	1.0 × 10³b B	13.5 × 10³bcd B	270.0 × 10³a B	309.0×10⁵a A
SL	2%	IM	T2	3.0 × 10³a D	2.5 × 10³b D	34.5 × 10³a C	217.5 × 10³a B	298.510³× b A
		SP	T3	4.0 × 10³ a C	3.0 × 10³ab C	2.5 × 10³ d C	13.0 × 10³c B	123.0 × 10³ b A
	4%	IM	T4	5.0 × 10³a B	4.0 × 10³ab B	7.5 × 10³cd B	29.0 × 10³bc B	169.5 × 10³ b A
		SP	T5	3.5 × 10³a B	3.5 × 10³ab B	2.5 × 10³d B	106.5 × 10³b A	136.0 × 10³ b A
SC	1%	IM	T6	3.0 × 10³ a B	3.0 × 10³ ab B	30.5 × 10³ a B	84.0 × 10³bc B	225.0 × 10³ b A
		SP	T7	2.5 × 10³ a B	7.5 × 10³ a B	27.0 × 10³ ab B	41.0 × 10³ bc AB	78.0 × 10³ b A
	2.5%	IM	T8	2.0 × 10³a B	2.0 × 10³b B	20.5 × 10³abc B	76.5 × 10³bc AB	144.0 × 10³b A
		SP	T9	1.5 × 10³a C	4.0 × 10³ab C	19.0 × 10³abc BC	30.0 × 10³bc B	65.0 × 10³ b A

Means have different lower-case at the same column and upper-case at the same row are significantly different at ($p < 0.05$).
IM: Immersion, SP: Spraying.

Psychrotrophic bacterial count:

Table (3) shows psychrotrophic count (CFU/g meat) mean values of fresh chicken breast meat treated with two organic acids storage for seven days treated by sodium lactate and tri sodium citrate and stored for seven days. Before treated fresh chicken breast with the two organic acids (0 day), there no significant differences among treatments, the lowest psychrotrophic count mean values of fresh chicken breast meat recorded in T2,T5, T6 and T8 (0.5×10^2 CFU/g meat for all), while the highest psychrotrophic count mean values of fresh chicken breast meat recorded in T1, T8 and T9 (1.5×10^2 CFU/g meat for all). There are no standard Psychrotrophic bacterial count limits in Iraqi quality regulations to be compared with (ICOSQC, 2000; ICOSQC, 2006). After 1st day of experiment, results show that there were no significant differences among all treatments. The lowest psychrotrophic count mean value recorded in T3 (0.5×10^2 CFU/g meat), while the highest psychrotrophic count mean value recorded in T8 (3.5×10^2 CFU/g meat). In 3rd day, results show there were significant differences among treatments.

The lowest psychrotrophic count mean value recorded in T6 (3.5×10^2 CFU/g meat), while the highest psychrotrophic count mean value recorded in T1 (70×10^2 CFU/g meat). In 5th day, Table (4) shows there were significant differences among treatments. The lowest psychrotrophic count mean value recorded in T9 (36.5×10^2 CFU/g meat), while the highest psychrotrophic count mean values recorded in T1 (217×10^2 CFU/g meat). At the end day of experiment (7th day), results show that there were significant differences among treatments. The lowest psychrotrophic count mean value recorded in T4 (154×10^2 CFU/g meat), while the highest psychrotrophic count mean values recorded in T1, T6, T8 and T9 (250×10^2, 234×10^2, 243.5×10^2 and 232.5×10^2 CFU/g meat respectively). When compared the psychrotrophic count mean values within same treatment at different periods of experiment (Table 4). The results at end of experiment (7th day) clarified significant difference among other periods. The 7th day recorded highest psychrotrophic count mean value compared to other periods of experiment. The Psychrotrophic values were lower than total aerobic bacterial count (Tables 2, and 3), which may belong to that, the samples were bought fresh and the products did not stay for long periods in shops and markets, so the psychrotrophic bacteria did not have enough time to increase (Jay *et al*., 2005).

Results show that treated chicken breast meat by dipping in 4% sodium lactate causes in lower psychrotrophic bacterial counts (T4) when compared to other treatments, Hwang and Beuchat (1995) decontaminated the chicken skin with lactic acid and determined a 1 log/cm^3 reduction of psychrotrophic bacterial counts. Results show that psychrotrophic bacterial count at the 7th day differs significantly with other storage periods for most treatments (Table 3). As reported in the present study several authors had reported, that lactic acid treatment retarded the growth of pschrotrophic flora of chicken parts during refrigeration storage (Hwang and Beuchat, 1995, Serap *et al*., 2011). Some strains of species that fall into the indicator organism's categories (such as certain coliforms and *Enterobacter* from the family *Enterobacteriaceae*) are Psychrotrophic, and can multiply on refrigerated raw poultry carcasses and products (ICMSF, 1986). Some of pathogenic and food poisoning microorganisms are also Psychrotrophic in nature like *Salmonella* species*, StaPHylococcus, E.coli, Listeria*. (Sams, 2001; Mead, 2004; Jay *et al*., 2005). In food quality it's important to count the psychrotrophic bacteria, because any increase may lead to more pathogenic bacterial isolation and identification (USDA /FSIS, 1998). Significant reduction in the initial psycrotrophic count and Enterobacteriaceae count had been also verified in chicken after dipping in lactic acid and tri sodium phosphate (Okolocha and Ellerbroek, 2005; Deumier, 2006; Del Río *et al*., 2007). Under normal aerobic packaging conditions, the shelf life of refrigerated meat is limited by the growth, and biochemical activities of aerobic, psychrotrophic strains of bacteria (Lambert *et al*., 1991). Chemical decontamination prior to packaging can be used to extend the shelf life of fresh meat.

Table (3): Effect of sodium lactate and tri sodium citrate on PsychrotroPHic (CFU/g meat) of chicken breast.

Treatment			Periods(day)					
			TREAT	0	1st	3rd	5th	7th
Control			T1	1.5×10^2 a C	2×10^2 a C	70×10^2 a B	217×10^2 a A	250×10^2 a A
SL	2%	IM	T2	0.5×10^2 a C	1.5×10^2 a C	53×10^2 b BC	92×10^2 bc B	225.5×10^2 ab A
		SP	T3	1×10^2 a B	0.5×10^2 a B	27×10^2 cd B	132×10^2 abc A	182×10^2 abc A
	4%	IM	T4	1×10^2 a C	1.5×10^2 a C	14×10^2 de C	78×10^2 bc B	154×10^2 c A
		SP	T5	0.5×10^2 a C	1.5×10^2 a C	5.5×10^2 e C	99×10^2 bc B	164.0×10^2 bc A
SC	1%	IM	T6	0.5×10^2 a C	2×10^2 a C	3.5×10^2 e C	93×10^2 bc B	234×10^2 a A
		SP	T7	1.5×10^2 a B	1×10^2 a B	27.5×10^2 cd B	202.5×10^2 a A	212.5×10^2 abc A
	2.5%	IM	T8	0.5×10^2 a C	3.5×10^2 a C	35×10^2 c C	147.5×10^2 ab B	243.5×10^2 a A
		SP	T9	1.5×10^2 a D	2×10^2 a D	24.5×10^3 cd C	36.5×10^2 c B	232.5×10^2 a A

-Means have different lower-case at the same column and upper-case at the same row are significantly different at ($p < 0.05$).

IM: Immersion, SP: Spraying

Sensory evaluation:

Table (4) show the sensory traits of fresh chicken breast treated with sodium lactate and tri sodium citrate storage under refrigeration. For the period one (before treated), there were no significant differences among 9 treatments for color, flavor-aroma, tenderness and juiciness, while there were significant differences between treatments for over all acceptability. In terms of color, the highest mean value recorded in T8 (3.800), while the lowest mean value recorded in T4 (2.800), which achieved lower scores according to Cross *et al*., (1978). For the flavor and aroma, Treatments T7, T8 and T9 recorded the highest values, 4.800 for each one, while the lowest mean values recorded in T2 and T4 (3.400 and 3.400 respectively). According to Cross *et al*., (1978), all treatments had acceptable score. For tenderness, the highest mean values recorded in T9 and T1 (4.00 and 4.00 respectively), while the lowest value recorded in T3 (2.600), which is a low score according to Cross *et al*., (1978). For juiciness, the high mean value recorded in T9 (3.400), and the lowest mean value recorded in T4 (2.200), which is the unacceptable score according to Cross *et al*., (1978). For the overall acceptable, the highest mean value recorded in T9 (4.400), while the lowest mean value recorded in T2 (2.600), which is the lower score according to Cross *et al*., (1978). At the end of experiment (7th day) (Table 4), in terms of color, there were significant differences among treatments, the highest mean values recorded in T8, T7 and T6 (4.400, 4.400 and 4.400 respectively), while the lowest mean value recorded

in T4 (3.400). According to Cross *et al*., (1978), all treatment had acceptable scores. For the flavor–aroma, there were significant differences among treatments, the highest means values recorded in T9, T8, T7 and T6 (5.00 for all), while the lowest mean value recorded in T1 (3.00), which is the lowest score according to Cross *et al*., (1978). For tenderness, there were significant differences among treatments, the highest mean value recorded in T8 (4.400), while the lowest mean value recorded in T3 (2.800), which is the lowest score according to Cross *et al*., (1978). For juiciness, there were significant differences among treatments, the highest mean value recorded in T8 (2.600), while the lowest mean value recorded in T5. All treatments recorded lower or unacceptable score according to Cross *et al*., (1978). For over all acceptability, there were significant differences between treatments, the highest mean values recorded in T9 and T8 (4.200 for both), while the lowest value recorded in T1 (2.600), which is a low score according to Cross *et al*., (1978).

When compared between sensory traits in two periods (Table 4), there were no significant differences for all traits except color, and only color differ significantly between two periods in T3, T6 and T7, while the color in 7th day recorded more acceptable score. To determine the effects of sodium lactate and tri sodium citrate on sensory properties, cooked chicken breast meat was subjected for sensory evaluation. The use of any decontamination intervention to reduce microbial load without reducing sensory quality, thus the sensory studies are imported when an antimicrobial procedure is evaluated (Del Rio *et al.*, 2007). According to Table (4) results show that T5 (control) differ significantly among T6, T7, T8 and T9 for over all acceptability, while no significant differ recorded among other treatment. Other study recorded same results, similarly, Van Der Marel *et al.,* (1988) who found no effect of lactic acid on the meat of broiler. Sensory traits of sodium lactate treatment (except T3) recorded same similar ($p>0.05$) to score of control treatment. Results of color showed that T4 treatment differ among treatments of T6, T7 and T8. Color is important sensory characteristics of meat due to its impact on purchasing decision of consumers (Fletcher, 1999). The effect of organic acid on the sensory qualities of meat and poultry was studied by a number of researchers, Dickens and Whiltmore (1997) did not observe any differences in skin appearance of chicken carcasses due to acetic treatment. Snijders *et al.,* (1985) determined that lactic acid at the concentration did not affect the sensory properties such as color and flavor, also Ugar *et al.,* (1995) had mentioned that dipping of chicken carcasses in lactic or acetic acid solution did not make a change in skin color and taste.

Table 4. Sensory evaluation of refrigerated chicken breast treated with sodium lactate and tri sodium citrate

Treatment				Periods(day)									
				٠ day					7th day				
				color	Flavor-aroma	Tenderness	juiciness	Overall-acceptability	color	Flavor-aroma	Tenderness	juiciness	Overall-acceptability
control			T1	3.400 a A	3.800 a A	4.000 a A	3.200 a A	2.800 bc A	4.000 ab A	3.000 b A	3.200 ab A	2.200 a A	2.600 c A
SL	2%	IM	T2	3.200a A	3.400 a A	3.000 a A	2.800 a A	2.600 c A	3.600 ab A	4.000 ab A	4.200 a A	2.000a A	3.000 abc A
		SP	T3	3.200a B	3.800 a A	2.600 a A	2.400 a A	3.000 bc A	4.000 ab A	4.800 a A	2.800 b A	2.400 a A	3.800 ab A
	4%	IM	T4	2.800a A	3.600 a A	3.400 a A	2.200 a A	2.800 bc A	3.400 b A	4.000 ab A	3.200 ab A	2.200a A	3.000 abc A
		SP	T5	3.600a A	3.400 a A	4.000 a A	2.800 a A	3.400 abc A	3.800 ab A	4.400 a A	3.400 ab A	1.800a A	2.800 bc A
SC	1%	IM	T6	3.400a B	4.200 a A	3.800 a A	3.000 a A	4.000 ab A	4.400 a A	5.000 a A	3.600 ab A	1.600a A	4.000 a A
		SP	T7	3.600a B	4.800 a A	3.400 a A	2.800 a A	4.000 ab A	4.400 a A	5.000 a A	3.600 ab A	2.200 a A	4.000 a A
	2.5%	IM	T8	3.800a A	4.800 a A	3.400 a A	2.400 a A	3.800 abc A	4.400 a A	5.000 a A	4.400 a A	2.600 a A	4.200 a A
		SP	T9	3.600a A	4.800 a A	4.000 a A	3.400 a A	4.400 a A	4.20 ab A	5.000 a A	4.200 a A	2.000a A	4.200 a A

-Means have different lower-case at the same column and upper-case at the same row are significantly different at ($p < 0.05$). IM: Immersion, SP: Spraying.

Conclusion:

The treated fresh chicken breast meat with sodium lactate and tri sodium citrate can be used for increasing shelf life of breast meat. The tri sodium citrate, and spraying treatments recorded better results than other organic acid and immersion treatments.

References:

Ali, F.H. (2010). Probiotics feed supplement" to improve quality of broiler chicken carcasses. World J. Dairy Food Sci., 5:93- 99.

Al-Rubaei, A.M.S.; S.J. Hamudy; and J.E.H. Al-Mashhadany (2007). Studying certain quality of broiler meat fed on feeds containing chamomile plant. J. Egypt Food and Feed. 2:843- 856.

Al-Sheddy, I.; M. Al-Dagal; and W.A. Bazaraa (1999). Microbial and sensory quality of fresh camel meat treated with organic acid salts and/or Bifidobacteria. Journal of Food Science. 64 (2): 336–339.

Anower, A.K.M.M.; M.M. Rahman; M.A. Ehsan; M.A. Islam; and M.R. Islam (2004). Bacteriological profile of dressed broilers and its public health implications. Bangl. Journal veterinary Medicine. 2(1):69- 73.

AOAC; Association of Official Analytical Chemists (1995). Official Methods of Analysis. 17th Ed., Association of Official Analytical Chemists, Arlington.

APHA; American Public Health Association (1992). Compendium of methods for the microbiological examination of food, 3rd Ed., Washington, DC. New York.

Bacon, R.T.; J.N. Sofos; K.E. Belk; J.O. Reagan; and G.C. Smith (1999). Commercial evaluation of multiple-sequential interventions for decontamination of beef carcasses, Beef Program Report. Department of Animal Sciences, Colorado State University, USA.

Benjakul, S.; W. Visessanguan; S. Riebroy; S. Ishizaki; and M. Tanaka (2002). Gel forming properties of bigeye snapper, *Priacanthus tayenus* and *P. macracanthus*, stored in ice. Journal Science Food Agriculture. 82: 1442- 1451.

Berri, C. (2000). Variability of sensory and lipid oxidation in broilers exposed to high temperature at an early age. Br. Poultry Science. 41:489- 493.

Canibe, N.; R.M. Engberg; and B.B. Jenson (2001). An overview of the effect of organic acids on gut flora and gut heath. Danish Institute of Agriculture Sciences. Denmark. Pp 14.

Cann, D.L.; G.L. Smith; and N.G. Houston (1983). further studies on marine fish stored under modified atmosphere packaging. Ministry of Agriculture Fisheries and Food, Torry Research Station, Aberdeen. (Cited by Kashiri *et al.*, 2011).

Chen, N.; and L.A. Shelef (1992). Relationship between water activity, salts of lactic acid, and growth of *Listeria monocytogenes* in a meat model system. Journal of Food Protection. 55(8): 574- 578.

Chueachuaychoo, A.; S.Wattanachant; and S. Benjakul (2011). Quality characteristics of raw and cooked spent hen Pectoralis major muscles during chilled storage: Effect of salt and PHosPHate. International Food Research Journal. 18: 601- 613.

Cross, H.R.; R. Moen; and M. Stanfield (1978). Training and testing of judges for the sensory analysis of meat quality. Food Technology. 32:4852-. (Cited by Jeffrey,2011).

Cutter, C.N. (1999). Combination spray washes of saponin with water or acetic acid to reduce aerobic and pathogenic bacteria on lean beef surfaces. Journal of Food Protection. 62: 280- 283.

Del Río, E.; M. Panizo-Morán; M. Prieto; C. Alonso-Calleja; and R. Capita, (2007). Effect of various chemical decontamination treatments on natural microflora and sensory characteristics of poultry. International Journal. Food Microbiology. 115: 268- 280.

Deumier, F. (2006). Decontamination of deboned chicken legs by vacuum-tumbling in lactic acid solution. Int. J. Food Science Technology. 41: 23- 32.

Dickens, J.A.; and A.D. Whittemore (1997). Effects of acetic acid and hydrogen peroxide application during defeathering on the microbiological quality of broiler carcasses prior to evisceration. Poultry Science. 67:657- 660

Dickens, T.A.; N.A. Cox; and A. Greer (1992). The effect of air scrubbing on moisture pickup, aerobic plate counts, *Enterobacteriaceae* and the incidence of *salmonellae* on artificially inoculated broiler carcasses. Poultry Science. 71(3): 560- 564.

FAO: Food and Agriculture Organization (1965). Specifications for the identity of food additives and their toxicological evaluation: Some antimicrobials, antioxidants, emulsifiers, and stabilizers flour treatment agents, acid and bases, 9th Report of the Joint FAO/WHO Expert Committee on Food Additives. FAO Nutrition Meeting Report Series No. 40. (Cited by Taher *et al.,* 2012).

FAO; Food and Agriculture Organization of United Nation (1992). Manual of Food Quality Control, Microbiological Analysis.

Fletcher, D.L. (1999). Broiler breast meat color, variation, PH, and texture, Poultry Science. 78:1323-1327.

Francois, D. (2004). Pulsed-vacuum immersion of chicken meat, and skin in acid solutions: Effects on mass transfers colour and microbial quality. Int. Journal of Food Science Technology. 39 (3): 277- 286.

FSIS; Food Safety and Inspection Service, Office of Public Health Science (1995). Meat preparation, water in meat and poultry. Fact sheet.

Hudha, M.N.; M.S. Ali; M.A.A. Azad; M.M. Hossian; M. Tanjim; S.C. Bormon; M.S. Rahman; M.M. Rahman; and A.K. Paul (2010). Effect of acetic acid on growth and meat yield in broilers. Int. J. BioRes., 1 (4): 31- 35.

Hwang, C.; and L.R. Beuchat (1995). Efficacy of selected chemicals for killing pathogenic and spoilage microorganisms on chicken skin. Journal of Food Protection. 58:1923.

ICMSF; International Commission on Microbiological Specification for Foods (1986). Microorganisms in Foods 2. Sampling for microbiological analysis: Principles and specific applications, 2nd Ed. University of Toronto Press, Toronto, Canada. Available at:http://www.icmsf.iit.edu/pdf/icmsf2.pdf.

ICOSQC; Iraqi Central Organization for Standardization and quality control (2006). IQS 2270/4. Microbiological limits in foods/ part 4. Microbiological limits of meat and meat products. Iraq. (in Arabic).

ICOSQC; Iraqi Central Organization for Standardization and quality control (2000). IQS 3725/4. Microbiological limits in foods/ part 4. Microbiological limits of meat and meat products. Iraq. (in Arabic).

Islam, M.Z.; Z.H. Khandaker; S.D. Choudhury; and K.M.S. Islam (2008). Effect of citric acid acetic acid on the performance of broilers. Journal Bandladesh Agril. University. 6(2): 315- 320.

ISO: International Standard Organization (1995). Recommendation of the meeting of the subcommittee, International Organization for Standardization, on meat and meat products. ISO/TC-36/Sc-6. PP. 10- 18. Netherlands.

Jay, J.M.; MJ. Loessner; and D.A. Golden (2005). Modern food microbiology, 7th ed. Springer Science. Business Media Inc.

Karaboz, I.; and B. Dincer (2002). Microbiological investigations on some of the commercial frozen meat in Izmir, Turkish Electronic Journal of biotechnology, Special issue 18- 23.

Kozačins. L.; Ž. C. Fleck; Z. Kozačinski; I. Lipović; M. Mitak; M. Bratulić, and M. Tomislav (2012). Evaluation of shelf life of pre-packed cut poultry meat. Veterinarski arhiv 82 (1): 47- 58.

Lambert, A.D.; J.P. Smith; and K.L. Dodds (1991). Combined effect of modified atmosphere packaging and low-dose irradiation on toxin production by *Clostridium botulinum* in fresh pork. J. Food Protect., 54:94- 101.

Mead, G.C. (2004). Microbiological quality of poultry meat: a review. Brazilian J. of Poultry Sci., 6(3):135 – 142.

Michael, H. (2000). Microbial control in the meat industry. Microbiology. 4: 493- 499.

Mohizea, T.S.; A.S. Mashhadi; A. Fawwal; and A. Al-Shalhat, (1994). Microbiological and shelf life assessment of chilled eviscerated whole chicken broilers in Saudi Arabia. British Poultry Science. 35(4): 519- 526.

Morshedy, A.M.A.; and KH. I. Sallam (2009). Improving the microbial quality and shelf life of chicken carcasses by trisodium phosphate and lactic acid dipping. International Journal of Poultry Science. 8: 645- 650.

Naveena, B.M.; and S.K. Mendiratta (2001). Tenderization of spent hen meat using ginger extract. British Poultry Science. 42: 344–350.

Okolocha, E.C.; and L. Ellerbroek (2005). The influence of acid and alkaline treatments on pathogens and the shelf life of poultry meat. Food Control. 16: 217- 225.

Owens, C.M.; and A.R. Sams (2000). The influence of transportation on turkey meat quality. Poultry Science. 79: 1204- 1210.

Perumalla, A.V.S.; S.H. Navam; F.O. Kenneth; C.R. Steven; E.G. Edward; Zh. Jinying; and D. Brad (2012). Effect of potassium lactate and sodium diacetate combination to inhibit listeria monocytogenes in low and high fat chicken and turkey hotdog model systems. The Open Food Science Journal. 6:16- 23.

Petrová, J.; A. Pavelková; L. Hleba; J. Pochop; K. Rovná; and M. Kačániová (2013). antimicrobial effect of *Salvia officinalis* L. against selected group of bacteria isolated from chickens meat. Animal Science and Biotechnologies. 46 (2).

Pornaem, S.; E.A.E. Boyle; D.Y.C. Fung; F.M. Aramouni; and J.J. Higgins (2005). Refrigerated display life and quality characteristics of fresh, whole all-natural poultry. Session 97, Muscle Foods: Quality, IFT Annual Meeting. New Orleans, Louisiana.

Qiao, M.; D.L. Fletcher; D.P. Smith; and J.K. Northcutt (2002). Effects of raw breast meat color variation on marination and cooked meat quality. Poultry Science, 81: 276- 280.

Sams, A. R. (2001). Poultry Meat Processing. Texas A and M University.

Scheuermann, G.N. (2003). Breast muscle development in commercial broiler chickens. Poultry Science. 82(10): 1648- 1658.

Senter, S.D.; J.W. Arnold; and V. Chew (2000). APC values and volatile compounds formed in commercially processed, raw chicken parts during storage at 4 and 13 °C under simulated temperature abuse conditions. J. Sci. Food Agric., 80:1559–1564.

Serap ,C.; M. Suhendan; U.A. Didem; and T.S. Yasemin (2011). Effects of *Pediococcus spp.* on the quality of vacuum-packed horse mackerel during cold storage. Journal of Agricultural Sciences. 1760: 59- 66.

Smith, D.P.; C.E. Lyon; and B.G. Lyon (2002). The effect of age, dietary carbohydrate sours and feed withdrawal on broiler breast color. Poultry Sci., 81: 1584- 1588.

Snijders, J.M.A.; J.G. Van Logtestijn; D.A.A. Mossel; and F.J.M. Smulders (1985). Lactic acid as a decontaminant in slaughter and processing procedures. Vet. Quart., 7:277- 282.

Steel, R.G.D.; J.H. Torrie; and D.A. Dickey (1996). Principles and procedures of statistics" A biometrical approach. 3rd ed. McGraw Hill Book Company Inc, New York, USA.

Taher, S.A; R. Khaton; M.A.H. Fakir; M.A. Hasnat, and M.M. Rahman (2012). Effects of acetic acid

on the total viable counts of microbes and overall acceptability of dressed broiler meat. Univ. j. zoology. 31: 01- 04.

Tosun, H.; and A.Ü. Tamer (2000). A study on the effects of chilling on the microbial quality of poultry carcasses and surface decontamination with lactic acid. Turk Journal Veterinary Animal Science. 24: 517- 521.

Ugur M.; K. Bostan; Ö. Özgen; and H. Çolak (1995). Asetik asit solüsyonlarına daldırmanın broiler karkaslarının mikrobiyolojik kalitesi üzerine etkisi. stanbul Üniv. Vet. Fak. Derg., 21: 433- 442.

USDA/FSIS; United States Department of Agriculture Food Safety and Inspection Service (1998). Microbiology Laboratory Guidebook, 3rd Ed., Washington, DC: USDA–FSIS. http://www.fsis.usda.gov/Science/Microbiological_Lab_Guidebook/.

Van der Marel, G.M.; J.G. Van Logtestijn; and D.A.A. Mossel (1988). Bacteriological quality of broiler carcasses as affected by in-plant lactic acid decontamination. International Journal of Food Microbiology. 6: 31- 42.

Wattanachant, S.; S. Benjakul; and D.A. Ledward (2004). Composition, color, and texture of Thai indigenous and broiler chicken muscles. Poultry Science. 83: 123- 128.

Xiong, H.; Y. Li; M.F. Slavik; and J.T. Walker (1998). Chemical spray conditions for reducing bacteria on chicken skins. Journal of Food Science. 63:699–701.

Zeitoun, A.A.M.; and J.M. Debevere (1992). Decontamination with lactic acid/sodium lactate buffer in combination with modified atmosphere packaging effects on the shelf life of fresh poultry. Int. Journal Food Microbiology. 16: 89- 98.

Zhu, J.; F. Liu; X. Li; and R. Dai (2009). Effect of succinate sodium on the metmyoglobin reduction and color stability of beef patties. Journal Agriculture Food Chemistry. 57: 5976- 5981.

الخصائص الكيميائيّة والميكروبيّة والحسيّة للحوم صدور الدّجاج المبرّدة المعاملة بلاكتات الصوديوم وثلاثي سترات الصوديوم

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تاريخ الاستلام: 2017/05/27 تاريخ القبول: 2017/09/19

الملخص

هدفت الدّراسة الحالية إلى استخدام نوعين من الأحماض العضويّة هما: لاكتات الصوديوم، وثلاثي سترات الصوديوم، بغرض إطالة فترة التخزين للحم صدر الدّجاج الطازج، حيث عوملت عيّنات لحم الدّجاج بتراكيزٍ مختلفة من هذه الأحماض بطريقتي الرش والغمر. وزّعت العينات عشوائياً كما يلي: العينة الشاهد T1 (ماء مقطر)، المعاملتان T2 وT3 عوملتا باستخدام لاكتات الصوديوم بتركيز 2% (غمر ورش) على التوالي، والمعاملتان T4 وT5 استخدم فيها لاكتات الصوديوم بتركيز 4% (غمر ورش) على التوالي، واستخدم ثلاثي سترات الصوديوم بتركيز 1% للمعاملتين T6 و T7 (غمر ورش) على التوالي، وأخيراً عوملت المعاملتين T8 وT9 بثلاثي سترات الصوديوم بتركيز 2.5% (غمر ورش) على التوالي. عوملت كل عيّنة لحم بالحامض العضوي المحدّد لمدّة 10 دقائق، ثم حفظت بالتبريد على درجة حرارة 4 °م لفتراتٍ مختلفة من التخزين (0، 1، 3، 5، و7) أيام. خلال فترة التخزين أُجريت الفحوصات الكيميائيّة، والميكروبيّة، والحسيّة للعيّنات. في اليوم السابع من الخزن سجّلت المعاملة T1 أعلى قيمة PH بينما أعطت المعاملتان T6 و T9 أقل قيمة PH، وخلال المدّة نفسها سجّلت المعاملتان T9 وT7 أقل عدد للبكتريا الكليّة، وأعطت المعاملة T1 أعلى عدد للبكتريا الكلية، واختلفت هذه المعاملة معنويّاً عن بقية المعاملات. وفيما يخص البكتريا المحبّة للبرودة أعطت المعاملة T4 أقل تعداد للبكتريا مقارنة مع المعاملات T1 و T6 و T8 و T9 التي سجّلت أعلى تعداد للبكتريا. أمّا بخصوص التقييم الحسي فلم يسجّل فروق معنوية بين الصّفات المدروسة باستثناء صفة اللّون. وبناءً على ما ذكر يمكن استخدام لاكتات الصوديوم وثلاثي سترات الصوديوم لمعاملة لحم صدر الدجاج لإطالة مدة خزنه بالتبريد.

الكلمات المفتاحية: لاكتات الصوديوم، ثلاثي سترات الصوديوم، لحم صدر الدجاج ، فترة التخزين.