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Improving the Quality of Some Chicken Products with Some chemical Treatments

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Abstract

The aim of this study choose the best chemical treatments for improvement the quality of chicken products such as chicken breast and chicken thigh meat, to increase the shelf life by decrease the contamination with microorganisms. So, the some chemical materials (Sodium lactate, Sodium benzoate, Lactic acid and Tri Sodium Phosphate) are used for preparation the chemical solution at several concentrations for soaking the chicken products at several periods to choose the best chemical solution and soaking time for treated chicken products. Chemical analysis, physicochemical properties, freshness tests, microbiological examination and sensory evaluation are done. The obtained data showed that the second solution which contain (lactic acid 1.5% + sodium benzoate 0.5% + tri-sodium phosphate 1.5%) and fourth solution: (lactic acid 3% + sodium benzoate 0.5% + tri-sodium phosphate 2.5%) were high reducing the microbial load and eliminating microbes. The obtained data showed that the best solutions were Sol.(2) ,Sol.(4),Sol.(3) and Sol.(1),respectively and soaking time was 45 min. Results revealed that the use of optimum combinations of chemical preservative under investigation eliminated the largest possible number of microbes and improved the quality of the chickens product. Finally it is recommended that, the results of this research could be applied in factories to improve the quality of processed chicken products and reduce the microbial load.

Key words: Chicken; breast; thigh; shelf life; chemical preservatives

Introduction

Chicken is of great importance in the usual daily diet because it contains fats, proteins, vitamins, salts and minerals, which support human health. Therefore, the quality of the chicken must be preserved and the factors that negatively affect its color, smell, texture and flavor should be preserved. Among these factors that affect them are: In storage, transport, moisture, atmospheric oxygen level, indoor enzymes and microorganisms, play an important role in causing harmful changes in poultry. **(Faustman and Cassens, 1990)**.

Although food is necessary to maintain human health, it is the most toxic material to which a person is exposed. Therefore, a large number of physical, chemical, and biological methods have been used in the production chain to preserve and enhance its rheological, biological, physical and sensory properties of food. Therefore, about 2500 chemicals or more have been added directly to Various types of foods worldwide to enhance nutritional value, flavor, and stabilize color and texture, as well as to make them accessible to all **(Pressman *et al.*, 2017).**

The quality of meat products usually appears from their harvest until they reach the consumer and the loss of quality is often attributed to physical, chemical, enzymatic and microbiological changes that occur in chickens over time **(Davidson *et al.*, 2013)**.

In fact, through food preservation methods, the physical and chemical changes that occur during storage are reduced, which results in a better product, so the preservation methods include the basics of inhibiting the microbes and reducing the internal changes that affect the color and oxidation of the chicken is very important. The quality of poultry and the extension of the safe time between production and consumption (shelf life).**(Mustapha and Lee, 2017)**.

Antimicrobials are used during the treatment of chickens to control foodborne pathogens, including salmonella and campylobacter **(Nair and Kollanoor, 2017**). Antimicrobials such as sodium benzoate, sodium triphosphate, lactic acid, sodium lactate and peroxyacetic acid (PAA) and organic acids are used in washing water in re-treatment and cooling tanks in addition to their post-cooling addition. Antimicrobials can be used as a multi-obstacle approach to control Salmonella and Campylobacter For the preparation of terrestrial poultry products **(FSIS, 2010).**Sodium lactate and lactic acid are used as an aqueous solution on slaughtered chicken and in chicken parts.

Bolton *etal.* (2014) founded that chemotherapy treatments have the ability to prevent microbial damage and extend the shelf life of chicken and storage (3 days at 4°C) for sodium triphosphate (TSP 10-14%, w / v), lactic acid (LA 1-5% v / v). , Citric acid (CA 1–5%, w / v), peroxy oxides (POA 100 - 200 ppm) and acidic sodium chlorite (ASC 500 - 1200 ppm) were examined on TVC (mesophiles and psychrotrophs), Enterobacteriaceae, and Pseudomonas, lactic acid bacteria and yeasts / molds. At the treatment plant, microbial shelf life was obtained for approximately 4 days at 4°C on control samples (water treated) that spanned 1-2 days after TSP treatment (14%, regression) and up to 4 days with CA (5 %, Slipped). Poultry products are highly perishable with a short shelf life of 4 to 5 days, and chemical factors such as phosphate, especially sodium triphosphate (TSP) have been studied to a

large extent to verify their effectiveness as antimicrobials. Whole chicken carcasses treated with TSP were found to be more beautiful in appearance compared to untreated controls and were preferred by untrained team members even after the eighth day of storage. Likewise, whole chickens treated with trisodium polyphosphate (STPP) did not develop from the spleen until the eighth day of storage at 4°C, while untreated control samples had clay surfaces from day five**(Samant *et al.*, 2015).**

Treatment with 1% lactic acid solution is "very acceptable" when assessing the extent to which the odor is accepted by trained and untrained sensory arbitrators in raw and grilled chicken meat. Samples treated with lactic acid have demonstrated that their production outside odors is weaker compared to untreated control**(Pribić*et al.*, 2017).**

Lactic acid is an organic acid with inhibitory efficacy as an antiseptic of many types of food. It delays the reproduction of damaged microorganisms, prevents the generation of unwanted chemicals, improves the sensory characteristics of chickens and extends the storage life of chilled chickens **(Smaoui *et al.*, 2012)**.

Lactic acid is used as an antiseptic in various concentrations and processed chicken breast 3% of lactic acid, which gave the highest initial decrease in aerobic bacteria that love to spoil and psychological.**(Cosansu *et al.*, 2011).**

Material and methods:

Materials: Fresh chicken meat (breasts chicken and thighs chicken (shish), was obtained from United Egyptian Poultry Qalyubiya Company. The thighs and breasts of the fresh chicken were transported in ice box to the laboratory. Chemicals used were pure analytical grade. Tri-sodium phosphate, acetic acid, sodium lactate and sodium benzoate were obtained from El-gamhouria, company.

Methods: Chemical analysis: Determination of moisture, Crude protein, Crude fat according to the methods described by **A.O.A.C. (2012)** and ash content and Carbohydrates were calculated by difference.

- Freshness tests: Total volatile nitrogen (TVN) and Thiobarbutaricacid (TBA) were measured according to the method of **Harold *et al.* (1987).**
- Physical properties: pH value: The pH value was determined by homogenizing 10 g of the sample with 100 ml distilledwater for 30 sec. The pH of prepared sample was measured using a pH meter model Consort P107.
- Water holding capacity (WHC) and plasticity: Water holding capacity (WHC) and plasticity were measured according to the method described by **Soloviev (1966).**
- Total viable bacterial count: was determined using the plate count technique on total agar media was examined according to the methodology of the **American Public Health Association (1992) and Oxoid (1990).**
- Proteolytic bacteria: was counted according to the method described by **Harrigan and McCance (1976)**, the media used wasTryptic Glucose Yeast Agar media (containing 10% reconstitution sterile skim milk).
- Lipolytic bacteria: was counted according to the method described by **Zaki (1988),** the media used was Tryptic Glucose Yeast Agar media (containing 1% fat).
- Coliform bacterial count: as reported by the methodology of the **American Public Health Association (1992) and Oxoid (1990).**
- Molds and yeasts: Molds and yeasts were counted according to the method described by the methodology of the **American Public Health Association (1992) and Oxoid (1990).**
- Psychrophilic bacteria: was enumerated according to the American public health association **American Public Health Association (1992).**
- Sensory evaluation: The examined samples of chicken meat were analyzed for the quantification of the final sensory profile according to procedures of the **World's Poultry Science Association (1987).**

Statistical analysis: ANOVA was carried out on data of the sensory evaluation of camel sausage and chicken burger applying the function of two factors with replicates ″ Excel″ Software of MicrosoftOffice 2000. L.S.D. test was applied according to **Gomez and Gomez (1984).** Data are expressed as mean ± SE.

Results and Discussion:

Proximate chemical composition:

Data in **table (1)** show the main components in chicken breasts and chicken thighs. Chicken breasts contained74.24, 19.68, 3.37, 1.76 and 0.95% from moisture, crude protein, crud fat, total ash and total carbohydrates; respectively. While chicken thighs contained 74.96, 18.22, 4.27, 1.38 and 1.17 from the same components, respectively. Chicken breasts are considered to be an excellent source of protein. **(Abd El-Qader , 2014 and Pribic *et al.*, 2017).**

Sensory evaluation:

Both the chicken breast and the chicken thigh were acceptable but the chicken breast was superior to the chicken thigh, the main sensory features are: color, tenderness, juiciness and flavor. Nevertheless, many factors such as genetic, non-genetic factors, environmental and pre-slaughter factors and post mortem changes of muscle can affect the quality of poultry meat (**Tougan *et al.*, 2013 and Samant *et al.*, 2015)**.

Table 1. Proximate chemical composition of chicken breast and chicken thigh meat(g/100g on wet weight basis).

Component	Chicken breast meat	Chicken thigh meat
Moisture	**74.24±0.17**	**74.96±0.17**
Crude protein	**19.68±0.17**	**18.22±0.15**
Crude fat	**3.37±0.24**	**4.27±0.15**
Total ash	**1.76±0.13**	**1.38±0.19**
Total carbohydrates	**0.95**	**1.17**

Table 2. Sensory properties of chicken breasts and chicken thighs meat.

Properties	Chicken breast meat	Chicken thigh meat
	Total grade (12)	Total grade (12)
External aspect (3)	**2.00±0.06**	**2.54±0.14**
Odor (3)	**2.05±0.05**	**1.99±0.05**
Color (3)	**2.45±0.14**	**2.50±0.15**
Muscular elasticity (3)	**1.88±0.08**	**1.81±0.07**
Overall Score (12)	**9.66±0.18**	**10.33±0.37**
Sensorial Quality	**Excellent**	**Excellent**

- **Physicochemical properties**

It is clear in **Table (3)** that the concentration of hydrogen ion (pH) in the chicken breast is higher than that of the chicken thigh (pH). (chicken breast) because of the high percentage of red tissue in chicken breast from chicken breast and high percentage of fat in chicken thigh which recorded 5.66 and 5.31 of chicken breast and chicken thigh , respectively as indicated in **Table (3)**. Total volatile nitrogen was 2.80 and 3.83mg/100gofchicken breast and chicken thigh, respectively as a result of the high percentage of protein in the chicken breast and the height of the white tissue in the chicken breast compared to the low chicken thigh in the protein ratio. While, TBA value was 0.17 and 0.26 of chicken breast and chicken thigh meat, respectively. As for the ability to retain water holding capacity is high in the chicken breast (3.62) and less in chicken thigh (3.28) because of the difference and installation of the bottom (thigh) on the top (chicken breast). Protein, fat, moisture and the type of tissue is able to retain water. The plasticity is high in the chicken thigh due to the high percentage of fat in the blinds and lower in the chicken breast where recorded 4.10 and 4.25 in the chicken breast and chicken thigh and martyrdom**(Singh *et al.*, 2015and Cosansu *et al.*, 2011**).

Table 3. Physicochemical properties of chicken breast and chicken thigh meat.

Component	Chicken breast meat	chicken thigh meat
Total volatilenitrogen(mg/100g)	**2.80±0.14**	**3.83±0.14**
Thiobarbituric acid (TBA)	**0.17±0.08**	**0.26±0.11**
pH	**5.66±0.23**	**5.31±0.27**
Water holding capacity	**3.62±0.23**	**3.28±0.18**
Plasticity	**4.10±0.09**	**4.25±0.17**

Microbiological evaluation:

Table (4)indicate the all microbiological tests carried out, total count of bacteria, yeasts, molds, salmonella, etc., from the obtained results showed that both the chicken breast meat and the chicken thigh meat were related to the limits allowed in the **(Nair and Kollanoor, 2017)**.

Table 4. Microbiological evaluation of chicken breast and chicken thigh meat.

Microorganisms	Chicken breast meat	chicken thigh meat
Aerobic Plate Count	**1.1×10^5**	**2.6×10^5**
Coliform group	**7.4×10^3**	**1.4×10^4**
Lipolytic bacteria count	**1.8×10^4**	**2.9×10^4**
proteolytic bacteria count	**2.2×10^4**	**4.3×10^4**
Moldes and Yeast count	**1.0×10^3**	**2.0×10^3**
Psychrophilic bacterial count	**6.37×10^2**	**4.75×10^2**

Guided experiment to choose both the best chemical preservatives materials and the best times for soaking the chicken meat products (breasts and thighs) using the mixture of several chemicals, which has been a mix between the chemical materials and choose the best soaking solution is placed in washing water. Data in **(Table 5)** showed that the best time for soaking chicken breast meat and chicken thigh meat. The chicken breast and chicken thigh meats was placed in 7 solutions which mixed from several chemicals with each other (sodium lactate - sodium benzoate - lactic acid – Tri sodium phosphate) for 35-40-45 min to indicate the best time for soaking with the lowest number of total bacterial count and sensory acceptable. In the same table data indicated that the four solutions (No.1-4) which contain: SL (3.0%) + LA (2.0%) + TSP (2.0%), LA (1.5%) + SB (0.5%) + TSP (1.5%), LA (1.0%) + SB (0.3%) + TSP (1.0%), LA (3.0%) + SB (0.5%) + TSP (2.5) were the best solutions. These solutions were reducing total bacterial count of chicken breast meat and chicken thigh meat after 45 min to50 ,68 ,83 and 31 and 54, 62, 81and 48 for 1,2,3and 4solutions, respectively**(Bolton et al., 2014). O'Sullivan, (2016)**reported that, the chicken meat is susceptible to rapid spoilage due to high level protein and moisture.

Table 5. Total bacterial count of treated chicken breast and chickenthigh meat.

Treatments	Soaking time (min)					
	Chicken breast meat			Chicken thigh meat		
	30	40	45	30	40	45
Control	1.2×10^5	1.2×10^5	1.2×10^5	1.2×10^5	1.2×10^5	1.2×10^5
T. (1) (S.L 3.0%) + (L.A2.0 %) + (T.S.P 2.0%)	3.1×10^3	1.3×10^3	50	3.6×10^3	7.8×10^2	54
T. (2) (L.A 1.5%) + (S.B 0.5 %) +(T.S.P 1.5%)	7.2×10^2	1.6×10^2	68	8.3×10^2	2.0×10^2	62
T. (3) (L.A 1.0%) + (S.B 0.3 %) + (T.S.P 1.0%)	5.8×10^2	1.8×10^2	83	6.3×10^2	1.9×10^2	81
T. (4) (L.A 3.0%) + (S.B 0.5 %) + (T.S.P 2.5%)	3.2×10^2	79	31	3.1×10^2	92	48
T. (5) (T.S.P 0.5%) + (L.A 1.5%)	4.3×10^3	5.7×10^2	3.1×10^2	2.7×10^4	1.9×10^3	3.2×10
T. (6) (S.L 2.0%) +(L.A 1.5 %) + (T.S.P 1.5%)	4.9×10^3	4.7×10^2	3.2×10^2	5.2×10^3	2.7×10^3	3.4×10
T. (7) (S.L 2.5%) +(L.A 1.0%) +(T.S.P 1.0%)	6.5×10^3	7.2×10^2	4.2×10^2	7.1×10^3	3.3×10^3	4.1×10

(T. (1) (S.L 3.0%) + (L.A 2.0 %) + (T.S.P 2.0%)
T. (2) (L.A 1.5%) + (S.B 0.5 %) + (T.S.P 1.5%)
(T. (3) (L.A 1.0%) + (S.B 0.3 %) + (T.S.P 1.0%)
(T. (4) (L.A 3.0%) + (S.B 0.5 %) + (T.S.P 2.5%)
(T. (5) (T.S.P 0.5%) + (L.A 1.5%)
(T. (6) (S.L 2.0%) + (L.A 1.5 %) + (T.S.P 1.5%)
(T. (7) (S.L 2.5%) + (L.A 1.0%) + (T.S.P 1.0%)

- **Sensory evaluation**

The sensory evaluation included several characteristics, such as the external shape, smell, color, muscle tone and total work of the total grades of the previous qualities. Data in **Table (6)**external aspect, odor, color, muscular elasticity, and overall score clear that the four solutions (1-4) have the highest grades. So, these solutions (1-4) were used to soaked the chicken breasts and chicken thighs meat to improve the chicken products such as, chemical agents such as phosphates, particularly tri sodium phosphate (TSP), have been studied to a great extent to validate their potency as antimicrobials. Whole chicken carcasses treated with TSP were found to be pinker in appearance compared to the untreated controls and were preferred by the untrained panelists even after the 8day of storage, (**Samant *et al*., 2015)**.

Finally, data in the same table showed that the sensory evaluation of the chicken breasts and thighs meat the top down got the small letters (a), which confirmed that the best solutions in the selection are the last four solutions, which took the symbols (Solution 1, 2, 3and 4). These solutions are the best solutions in the addition of (lactic acid - sodium benzoate - tri sodium phosphate)**.**

Table 6. Sensory evolution of chicken breasts and chicken thighs meat treated with chemical preservations.

Treatments	Chicken breast meat					Chicken thigh meat					
	External aspect (3)	Odor (3)	Color (3)	Muscular elasticity (3)	Overall Score (12)	External aspect (3	Odor (3)	Color (3)	Muscular elasticity (3)	Overall Score (12)	Sensorial Quality
Control	2.62±0.18 aa	2.18±0.18 ab	1.75±0.16 bb	2,37±0.16 ab	10.25±0.31 ab	2.87±0.12 ab	2.62±0.18 ab	2.50±0.18 ab	2.50±0.18 ab	10.12±0.44 ab	Excellent
Sol.(1):S.L(3.0%)+L.A(2.0%)+ T.S.P(2.0%)	2.00±0.18 ab	1.62±0.18 bc	1.92±0.17 ab	2.62±0.18 aa	9.25±0.25 ab	2.56±0.17 ab	2.06±0.30 ab	2.62±0.18 ab	2.62±0.18 ab	9.68±0.49 ab	Excellent
Sol.(2):L.A(1.5%)+S.B(0.5%)+ T.S.P(1.5%)	2.00±0.26 ab	2.37±0.18 aa	2.37±0.18 aa	2.56±0.14 ab	10.50±0.32 aa	2.21±0.21 bc	2.75±0.16 aa	2.25±0.16 ab	2.25±0.16 ab	9.93±0.40 ab	Excellent
Sol.(3):L.A(1.0%)+S.B(0.3%)+ T.S.P(1.0%)	2.18±0.26 aa	1.71±0.16 bb	2.06±0.19 ab	1.50±0.18 bc	9.62±0.26 ab	2.57±0.16 ab	2.25±0.25 ab	2.43±0.17 ab	2.43±0.17 ab	10.06±0.46 ab	Excellent
Sol.(4):L.A(3.0%)+S.B(0.5%)+ T.S.P(2.5%)	2.00±0.18 ab	2.25±0.16 ab	2.32±0.13 aa	2.53±0.13 ab	10.37±0.37 aa	3.00±0.00 aa	2.56±0.17 ab	2.50±0.18 ab	2.50 ±0.18 ab	10.75±0.32 aa	Excellent
Sol(5):S.L(2.0%)+L.A(1.5%)+ T.S.P(1.5%)	1.68±0.36 bc	1.68±0.36 bc	1.38±0.24 bc	1.83±0.11 bc	5.87±0.22 c	1.75±0.25 c	2.25±0.25 ab	2.00±0.37 ab	2.00±0.37 ab	7.75 ±0.55 ab	Acceptable
Sol(6):T.S.P (0.5%)+L.A(1.5%)	1.62±0.32 bc	1.50±0.26 bc	1.12±0.22 c	0.62±0.18 c	5.50±0.32 c	1.75±0.36 c	1.87±0.30 bc	2.50±0.18 ab	2.50±0.18 ab	7.62±0.91 bc	Acceptable
Sol.(7):S.L(2.5%)+L.A(1.0%)+ T.S.P(1.0%)	1.50±0.32 bc	1.37±0.26 bc	1.58±0.22 bc	0.62±0.18 c	6.12±0.29 c	2.18±0.26 bc	2.18±0.13 ab	2.12±0.29 ab	2.12±0.29 ab	8.62±0.54 bc	Acceptable
LSD at 0.05%	0.754430	0.6425122	0.544323	0.4621955	0.833412	0.7325	0.752291	0.66519	0.661576	1.6215	

a, b & c: There is no significant difference (P>0.05) between any two means, within the same column have the same super script letter.

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تحسين جوده بعض منتجات الدجاج ببعض المعاملات الكيماوية

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قسم الصناعات الغذائيه– (كليه الزراعه)–جامعه بنها–مصر

الهدف من هذه الدراسة هو اختيار أفضل المعاملات الكيماوية لتحسين جودة بعض منتجات الدجاج(صدرووررك الدجاج المخلي)وتقليل التلوث بالكائنات الحية الدقيقة وإطالة العمر التخزيني لها. لذلك ، تم استخدام بعض المواد الكيميائية المصرح باستخدامها وهي حمض اللاكتيك ,لاكتات صوديوم ,بنزوات الصوديوم وثلاثي فوسفاتالصوديوموالتي تم استخدامها بنسب مختلفةسواء منفردة أو بخلطها مع بعضها وتحضيرها في صوره محاليل وتم نقع منتجات الدجاج لمدد مختلفة لاختيار كل من أفضل المواد ومدة النقع المناسبة لمعاملة منتجات الدجاج دون التأثير على كل من خصائصها الحسية ,الميكروبيولوجية , الكيميائية والقيمة الغذائية. وتم إجراء التحاليل الكيمائيهوالفيزيائية واختبارات الطزاجة والفحص الميكروبيولوجي والتقييم الحسي وأظهرت النتائج المتحصل عليها أن المحلول الثاني الذي يحتوي علي (1.5%حمض اللاكتيك+0.5%بنزوات صوديوم +1.5%ثلاثي فوسفات الصوديوم) والرابع الذي يحتوي (3%حمض اللاكتيك +0.5%بنزوات صوديوم +2.5% ثلاثي فوسفات الصوديوم) والذى تم نقعها لمده 45 ق قد حسنت من جودة منتجات الدجاج تحت الدراسةولم تؤثر علي التركيب الكيميائي كما أنها قللت الحمل الميكروبي لهذه المنتجات ومن النتائج المتحصل عليها أتضحأن المحاليل من (1–4) هي الأفضل في معاملة منتجات الدجاج من الناحية الميكروبيولوجية والحسيةولذا يوصي بأخذ هذا البحث في الإعتبار وتطبيقه في المصانع لتحسين جودة منتجات الدجاج وتقليل الحمل الميكروبي بها للحفاظ عليها وتلبية متطلبات المستهلك من حيث الحصول علي منتجات ذات جودة عالية.

الكلمات المفتاحيه: شرائح صدور الدجاج –فخذ الدجاج المخلي– المواد الحافظة المضافة–تحسين .