



## IMPROVEMENT SOME OF CHEMICAL AND PHYSICAL PROPERTIES OF THE SPENT HENS MEAT BY USING NATURAL TENDERIZERS MATERIALS

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### ABSTRACT

This present study aimed to know effect of treating spent hens meat by natural and availed tenderized materials that does not cause harms to product's nature or to consumer's health in the qualitative properties of this meat. Breast and thigh meat samples were taken , bones and fatty tissues were removed and they were cut separately into slices and distributed to 4 treatments with 3 replicates included: First treatment was treating their samples by distilled water (control) , second , third and fourth treatments were treating their samples by 50% of kiwi juice, lemon juice and apple vinegar solutions respectively .The results show rise of moisture rate significantly ( $p < 0.05$ ) in the breast meat samples that were immersed in solutions of kiwi juice (T2), lemon juice (T3) and apple vinegar (T4) compared with distilled water immersed samples (T1) as control treatment. Percentage of protein in (T2) treatment and fat ratio in (T3) treatment significantly decreased ( $p < 0.05$ ) and fat and carbohydrate ratios in (T2) treatment increased compared with T1, T3, T4 treatments and with (T3) and (T4) treatments respectively . Moisture rate increased significantly ( $p < 0.05$ ) in thigh meat samples of (T3) treatment followed by the sample of (T2) and (T4) treatments compared with (T1) treatment (control). Protein , fat and dry matter ratios decreased significantly in T2, T3 and T4 treatments compared with (T1) treatment, while carbohydrate ratio increased significantly ( $p < 0.05$ ) in T2 and T4 treatments compared with (T1) treatment . The highest pH value was in T1 and T2 treatments and best water holding capacity of breast meat samples significantly was in T2 and T3 treatments and thigh meat samples of T1 and T2 treatments gave significant superior water holding capacity and significant decline in loss of drip loss ratio and thawing loss ratio of breast meat samples in T2, T3 and T4 treatments respectively compared with T1 treatment. There was also significant decline in these two properties of thigh meat samples in T2, T3 and T1 treatments.

**KEY WORDS:** kiwi juice, lemon juice, apple vinegar, qualitative properties, spent hen's meat.

### INTRODUCTION

The poultry meat occupy good rank in food chain due to their high vital value of animal proteins besides their low fats and cholesterol ratios, so poultry meat production has been advanced over others of meat production sources and became one of the international main meat production resources and all of world countries seek to rise their people meat consumption to increase their nutrition level .The laying chickens are considered as well meat producer after end of its egg production period which lasts nearly for one and half year , so its meat characterized by less tenderization and less juice and a huge numbers were excluded after end of its production period and they were sold in local markets in cheap prices compared with chicks meat , these two properties were effected largely by kind and age of the animal (Taher , 1983; Al-Fayath and Naje, 1989; Das *et al.*, 1989 ; BahaAldeen *et al.*, 2013). Many attempts were carried out to improve tenderization of spent hens meat property through improving its qualitative properties by using industrial enzymes, salt solutions, plant extracts and organic acids (Al- Hajo, 2009; Homade *et al.*, 2010; Al-Alwane, 2010; Baha Al-Deen *et al.*, 2013; Al-Kasas, 2014). This study aims to test possibility of improving chemical and physical properties of the spent hen's meat by using quick

and alternative ways depending on using some of local and natural, cheap price, available and healthy safe materials such as kiwi juice, lemon juice, apple vinegar solutions because these ways are considered the more usage in houses and restaurants .

### MATERIALS & METHODS

This study was conducted on 22spent laying hens, 24 month old. After slaughtering and decomposition the breast and thigh from each chicken were taken, bones and fatty tissues were removed and they were cut separately into slices 1.5 cm thick and 100 gram weight for each cut. After water surface washing , the cuts samples of breast and thigh were taken individually for the general chemical structure determination and they were immersed in different solutions contained 50% of kiwi juice , lemon juice and apple vinegar solutions, and distilled water was also used for samples immersion and it was considered as control treatment. The meat pieces samples were distributed into 4 treatments - 3 replicates and they were as follows:

First treatment (T1): immersion in distilled water (control treatment).

Second treatment (T2): immersion in 50% kiwi juice solution.

Third treatment (T3): immersion in 50% lemon juice solution.

Fourth treatment (T4): immersion in 50% apple vinegar solution.

All treated samples were kept individually at refrigerator at 4 C° for 4 hours, then the sample were taken out the solutions and some measurements on these samples were done before freezing and then the samples were kept in polyethylene bags and closed tightly and stored frozen at (-18 C°) till time of test. The chemical composition analysis of breast and thigh samples was done by using the standard ways that were monitored in A.O.A.C (2005). The pH value of the samples was determined according to Xiong *et al.* (1993). Drip loss was estimated according to method of Nam *et al.* (2000) and ratio of thawing loss was got by method of Alvarado and Sams (2002) and method of Denhartog *et al.* (1997) was followed to determine meat water holding capacity (WHC).

## RESULTS & DISCUSSION

Table (1) shows effect of natural tenderized materials on chemical structure of breast and thigh of spent hens meat, the results show significant increase ( $p < 0.05$ ) in sample moisture ratio which treated with kiwi juice, lemon juice and apple vinegar solutions compared with the distilled water treated samples (control). The mediums indicated that the moisture percentage ratio in control treatment samples (T1) was 71.57% while this ratio increased significantly in kiwi juice (T2), lemon juice (T3) and apple vinegar (T3) to 75.80, 76.70 and 76.01 % respectively. The protein ratio in breast sample was 20.35% in (T1) treatment while slight decline was got (not significant) in breast meat samples that were treated with lemon juice (T3) and apple vinegar (T4) which were 18.85 and 19.21% respectively, while in the breast meat samples, the protein ratio value was declined significantly compared with the control treatment but there was no significant difference with T3 and T4 treatments. The result in this table referred also to presence of significant increase ( $p < 0.05$ ) in fat ratio of the breast meat sample that were treated with Kiwi juice (T2) compared

with rest treatments and (T3) treatment which were their meat samples immersed in lemon juice recorded significant decline and mediums in T2 and T3 were 1.06 and 0.13% respectively T4 which was treated with apple vinegar solution did not differ significantly with T1 (control). There was significant decreases ( $p < 0.05$ ) in ash ratio in all treatments which were treated with natural tenderized materials (T2, T3 and T4) compared with control treatment. When carbohydrate ratio was calculated it was shown that T2 (kiwi juice) got highest significant ratio (7.11%) compared with T3 and T4 treatments values which were 4.24 and 3.93% respectively, while the carbohydrate value was 6.78% in the control treatment and it was near the three treatments values mathematically and significantly. The control treatment showed significant increase ( $p < 0.05$ ) in dry matter ratio. Results of this study agreed with results of Jasim *et al.* (2008), Zinkina and Al-Jomaele (2010) and Homade *et al.* (2010) who referred to rise of moisture ratio and decline of protein ratio when spent hen meats were treated with acids, salts, plant extracts and industrial enzymes and that was also noticed in this study when breast cuts were immersed in kiwi juice (T2) and these results did not agree with findings of Al-Fayath *et al.* (2005) who found increase of protein ratio when spent hens meat cuts were immersed in vinegar solution compared with control treatment and T4 did not exceed the control treatment when their samples were immersed in apple vinegar solution, the results were mathematically and significantly approximate. The reason of increase of moisture ratio may be due to the role of the natural tenderized materials in increasing water holding capacity (WHC) and then increasing the moisture content, this may be lead to possibility of getting improvement in water loving properties of these meats due to the amphitheater reaction of protein molecule and polarity of water molecules (Lehninger, 1982). Becker and Tzeng (1981) indicated that when animal got older, the fat ratio increases and the moisture, protein and ash ratios of meat decreases and these phenomena was observed in this study when breast cuts of the spent hens were treated with kiwi juice and this may be related to that kiwi juice has good activity as antioxidant and it contains natural antioxidant (Al-Dere, 2003).

**TABLE 1:** Effect of natural tenderized materials on chemical structure of breast meat

| treatments        | kind              | Moisture %                   | Protein%                      | Fat%                        | Ash%                        | Carbohydrates%               | Dry matter %      |
|-------------------|-------------------|------------------------------|-------------------------------|-----------------------------|-----------------------------|------------------------------|-------------------|
| T1                | Distilled water   | 71.57 <sup>b</sup><br>± 0.90 | 20.35 <sup>a</sup><br>± 0.78  | 0.66 <sup>b</sup><br>± 0.24 | 0.64 <sup>a</sup><br>± 0.01 | 0.78 <sup>ab</sup><br>± 1.50 | 28.43a<br>± 0.90  |
| T2                | Kiwi juice 50%    | 75.82 <sup>a</sup><br>± 0.93 | 15.78 <sup>b</sup><br>± 1.88  | 1.06 <sup>a</sup><br>± 0.22 | 0.21 <sup>b</sup><br>± 0.02 | 7.11 <sup>a</sup><br>± 2.8   | 24.17b<br>± 0.93  |
| T3                | Lemon juice 50%   | 76.70 <sup>a</sup><br>± 0.68 | 18.85 <sup>ab</sup><br>± 0.64 | 0.13 <sup>c</sup><br>± 0.03 | 0.08 <sup>c</sup><br>± 0.03 | 4.24 <sup>b</sup><br>± 0.09  | 23.30c<br>± 0.68  |
| T4                | Apple vinegar 50% | 76.01 <sup>b</sup><br>± 0.53 | 19.21 <sup>ab</sup><br>± 0.45 | 0.67 <sup>b</sup><br>± 0.05 | 0.18 <sup>b</sup><br>± 0.04 | 3.93 <sup>b</sup><br>± 0.08  | 23.99bc<br>± 0.53 |
| Significant level |                   | *                            | *                             | *                           | *                           | *                            | *                 |

Different letters refers to significant differences between treatments ( $p < 0.05$ )

Data of table (2) indicate the effect of natural tenderized materials on chemical structure of thigh meat samples, the results showed significant increase ( $p < 0.05$ ) in moisture content of these samples (T2, T3 and T4) compared with control treatment (T1) (76.01, 73.82, 73.75 and 70.71%) respectively while values of protein ratio (17.74%) and fat ratio (4.00%) were significantly ( $p < 0.05$ ) higher in control treatment (T1) compared with T2, T3 and T4 which they did not significantly differ with each other and their protein ratios were 13.88, 13.57 and 13.25% and fat ratios were 1.64, 1.70 and 1.49% respectively. There were non-significant differences in ash ratio between all experiment treatments while when carbohydrate ratio was estimated, it was noticed T2 and T4 got significant increase compared with T1 and they were 10.53, 11.35 and 7.28% respectively, while T3 recorded significantly and mathematically approximate value to control treatment (T1) and to T2 and T4 and it was 8.61%. It was also noticed that T1 gave highest dry matter content (29.50%) compared with other treatments, while T3 gave less dry matter ratio compared with T1, T2 and T4. Some results of this table agreed with finding of Homade *et al.* (2010) who noticed significant increase in moisture ratio in thigh meat of spent hen which immersed in ginger and pin apple extracts compared with thigh meat that was immersed in distilled water. Protein ratio in poultry meat is affected by many factors such as age. Andes (1984) in his study about properties of pies that were manufactured by using two kinds of chickens found that

protein percentage in chicks and spent hens were 19.4 and 21.3% and this ratio is also affected by kind of cut in which meat is taken. Salama (1993) found that protein ratio in breast meat was higher than this ratio in thigh meat. Al-Fayath *et al.* (2005) noticed immersion breast cuts of spent hens in vinegar solution for 6-12 hours caused significant rise ( $p < 0.05$ ) in protein and ash ratios and this result does not agree with this research result in which significant decline observed with protein ratio when thigh cuts were immersed in kiwi, lemon and vinegar solution (T2, T3 and T4). Fat ratio in thigh meat samples that were immersed in distilled water was approximate to results of chemical analysis studies of different series of spent hens. Gorge (2004) mentioned that fat ratio in thigh meat ranged between 4 - 5% and treating with the natural tenderized material in this study (T1, T2 and T3) resulted significant decrease of fat ratio compared with control treatment (T1) which their samples were immersed in distilled water, so these results don't agree with finding of Al-Fayath *et al.* (2005) who got significant increase in ash and fat ratios in thigh meat samples of spent hens which were immersed in vinegar solution compared with thigh meat distilled water treated samples. Moisture average value decline in the control treatment resulted rise of dry matter ratio and vice versa was right when moisture ratio increased in kiwi juice, lemon juice and apple vinegar solution treated meat samples (T2, T3 and T4 treatments) and lastly caused decline in dry matter ratio.

**TABLE 2:** Effect of treating with natural tenderized materials by emersion method on chemical structure of thigh meat

| Treatments        | kind              | Moisture %      | Protein%         | Fat%            | Ash%           | Carbohydrate %   | Dry matter%      |
|-------------------|-------------------|-----------------|------------------|-----------------|----------------|------------------|------------------|
| T1                | Distilled water   | 70.71c<br>±1.18 | 17.74a<br>± 0.59 | 4.00a<br>± 1.15 | 0.33<br>± 0.16 | 7.28b<br>± 1.00  | 29.30a<br>± 1.18 |
| T2                | Kiwi juice 50%    | 73.82b<br>±0.25 | 13.88b<br>±0.61  | 1.64b<br>± 0.33 | 0.13<br>± 0.04 | 10.53a<br>± 1.10 | 26.18b<br>± 0.25 |
| T3                | Lemon juice 50%   | 76.01a<br>±0.58 | 13.57b<br>± 0.30 | 1.70b<br>± 0.15 | 0.11<br>± 0.02 | 8.61ab<br>± 0.73 | 24.00c<br>±0.58  |
| T4                | Apple vinegar 50% | 73.75b<br>±0.59 | 13.25b<br>± 0.40 | 1.49b<br>± 0.13 | 0.16<br>± 0.08 | 11.35a<br>±1.10  | 26.25b<br>± 0.59 |
| Significant level |                   | *               | *                | *               | N.S*           | *                | *                |

Different letters refers to significant differences between treatments ( $p < 0.05$ ). N.S: non significant

Table (3) shows effect of immersion of breast and thigh meat samples of the spent hens in different acid solutions (kiwi juice, lemon juice and apple vinegar) on PH value. The value of the breast cuts pH before treating with distilled water was 5.94 and it may be noticed in table (3) that medium pH value declined when meat sample were immersed in distilled water (control) and it was 5.84, while immersion breast meat samples in apple vinegar solution (T4) caused clear and significant decline ( $p < 0.05$ ) in pH value which was 4.83 compared with 5.84 in control, while there were non-significant differences in pH values between breast meat samples that were immersed in kiwi juice and lemon juice solutions (T2 and T3) and their pH values were 5.77 and 4.90 respectively and with control treatment (T1).

The results refer also to value of pH in thigh meat samples that were immersed in distilled water and the natural tenderized materials and pH value was 5.90 in the control treatment and 6.11 before treatment and there were non-significant differences between (T1) treatment and T2 and T3 treatments that were treated with kiwi juice and lemon juice solutions respectively. The thigh meat samples of apple vinegar solution treatment (T4) recorded significant decline in this property compared with control treatment (T1) but it did not differ significantly with (T3) treatments.

Table (3) results showed holding water capacity of breast and thigh meat samples that were immersed in the different acid solutions, significantly increased ( $p < 0.05$ ) in breast meat samples that were treated with kiwi and lemon juice

(T2 and T3) and these values were 36.13 and 36.41% respectively compared with control treatment (T1) and apple vinegar treatment (T4) and their values were 33.19 and 31.11% respectively. In the same trend (HWC) of kiwi and lemon juice treatments in thigh meat samples (T2 and T3) was increased significantly and their values were 38.23 and 37.82% respectively compared with samples of the apple vinegar treatment which had 33.03% while the last treatment did not differ significantly with the control treatment (T1). Results of this study agree with finding of Jasim *et al.* (2008) who got decrease in pH values of spent hens meat samples which were treated with different concentration of vinegar compared with control treatment (distilled water only), and they agree also with finding of Al-Dore (2010) who indicated that using different concentrations of organic acids individually caused pH values decrease but there were non-significant effect in most of the treatment especially with Ascorbic acid using, this was attributed to free fatty acids release by action of fats analyzed enzymes which gave low pH during storage or to possibility of some organic acids production by bacteria. The results of this study agree also with Al-kzaz (2014) who found significant decline ( $p < 0.05$ ) in pH values of the spent hens minced meat samples with increasing pomegranate peels powder concentration compared with the control treatment and he attributed that

pomegranate peels extract contains some of acid such, egiac acid and its derivatives which may cause pH decline and getting state near electric neutral point and then electrical power repulsion decreases between the protein bearing the charge itself (Taher, 1983). There was no agreement with results of Homade *et al.* (2010) who noticed significant increase ( $p < 0.05$ ) in pH value in breast cuts samples which were treated with the pineapple extract. The good positive and significant ability of the breast and thigh meat of the spent hens that were treated with kiwi juice and lemon juice (T2 & T3), and the breast meat samples that were immersed in distilled water (T1) to hold water may be attributed to increase of pH values or may be to rise of moisture content in the samples of these treatments. Results of the current study agreed with results of Homade *et al.* (2010) who got rise in (HWC) of breast and thigh meat samples which were immersed individually in ginger and pineapple solutions and, they agreed also with results of Al-Kzaz (2014) who got significant decrease ( $p < 0.05$ ) in (HWC) of the spent hen meat cuts which were treated with pomegranate peels extract and it was attributed to decrease of pH value of the treated chicken meat and that was seen in the fourth treatment (T4) which was treated with apple vinegar solution in this study.

**TABLE 3:** Effect of treating with natural tenderized materials on Ph value and water holding capacity in breast and thigh meat (HWC)

| Treatment         | kind              | pH Value     |              | WHC%         |               |
|-------------------|-------------------|--------------|--------------|--------------|---------------|
|                   |                   | Breast meat  | Thigh meat   | Breast meat  | Thigh meat    |
| T1                | Distilled water   | 5.84a ±0.08  | 5.90a ±0.13  | 33.19b ±0.82 | 33.78ab ±1.18 |
| T2                | Kiwi juice 50%    | 5.77a ±0.05  | 5.81a ±0.06  | 36.13a ±0.29 | 38.23a ±0.50  |
| T3                | Lemon juice 50%   | 4.90ab± 0.44 | 5.01ab ±0.11 | 36.41a ±0.43 | 37.82a ±0.90  |
| T4                | Apple vinegar 50% | 4.83b±0.34   | 4.92b ±0.35  | 31.11c ±0.74 | 33.03b ±0.72  |
| Significant level |                   | *            | *            | *            | *             |

Different letters refers to significant differences between e treatments ( $p < 0.05$ ).

Table (4) showed presence of significant differences in drip loss and thawing loss ratios among experiment treatments. There was a significant decline ( $p < 0.05$ ) in drip loss of breast meat samples which were treated with kiwi, lemon and apple vinegar solution (T2, T3 and T4) and their values were 3.02, 3.47 and 3.85% respectively compared with control treatment (T1) which was 4.31%. In the same last trend, this ratio declined in thigh tissue samples which were treated with kiwi and lemon juice solutions compared with the control treatment (T1) and mediums of T2, T3 and T1 were 2.86, 2.07 and 3.88% respectively while there was no significant difference between apple vinegar solution treatment (T4) and with the rest of treatments (T2, T3, T1) and its value was 3.15%. There was a significant effect ( $p < 0.05$ ) for the breast meat samples which were immersed in kiwi juice, lemon juice and apple vinegar solutions in thawing loss ratio compared with control treatment (T1) and the results showed that medium of this ratio was 4.22% in the control treatment (T1) and their ratio values decreased significantly when breast meat samples were immersed in kiwi, lemon and apple vinegar solution (T2, T3, T4) and

their values were 2.29, 2.44 and 3.43% respectively. It is also noticed that immersing thigh meat samples of spent hens in kiwi and lemon juice solutions decreased thawing loss and they were 2.05 and 2.14% respectively compared with the control treatment which was 4.64% and there were no significant differences in this property between the control treatment and apple vinegar treatment at which the ratio value was 3.45% and in the same time did not differ with T2 and T3 treatments. It may be concluded that decline of drip loss and thawing loss of both of breast and thigh meat samples which were treated with kiwi and lemon juices (T2 and T3) may be due to rise of moisture content (Table 1 and 2) of these samples with the control treatment and it may attributed to the ability of meat samples to hold water (table 3). These results agreed with results of Homade *et al.* (2010) who noticed significant decrease in ratio of drip loss and thawing loss of breast and thigh meat samples which were treated with pineapple extract compared with the control treatment and did not agree with results of Al-Kazaz (2014) who got significant increase in drip loss of experiment samples which were treated with pomegranate peels powder

compared with the control treatment (distilled water only). The increasing of drip loss from the fresh meat during storage or from the frozen meat during their thawing causes decline of nutrition value of meat due to presence of

important nutrients in this liquid (Al-Fayath *et al.*, 2011), so treating breast and thigh meat samples with kiwi, lemon and apple vinegar solutions in this study resulted meats having the necessary nutrient elements.

**TABLE 4:** Effect of treating with natural tenderized materials on drip loss and thawing loss of breast and thigh meat

| Treatments        | kind              | Drip loss %  |              | thawing loss % |              |
|-------------------|-------------------|--------------|--------------|----------------|--------------|
|                   |                   | Breast meat  | Thigh meat   | Breast meat    | Thigh meat   |
| T1                | Distilled water   | 4.31a± 0.11  | 3.88a± 0.10  | 4.22a± 0.18    | 4.64a± 0.18  |
| T2                | Kiwi juice 50%    | 3.02c± 0.07  | 2.86b± 0.24  | 2.29cd± 0.29   | 2.05b± 0.11  |
| T3                | Lemon juice 50%   | 3.47bc± 0.17 | 2.07c± 0.19  | 2.44c± 0.33    | 2.14b± 0.08  |
| T4                | Apple vinegar 50% | 3.85b± 0.08  | 3.15ab± 0.41 | 3.43b± 0.19    | 3.45ab± 0.18 |
| Significant level |                   | *            | *            | *              | *            |

\*Different letters refers to presence significant differences between treatments (p = 0.05).

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