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Effect of Some Vinegar Types on Sensory and Chemical Characteristics of Aged Chicken Meat

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Abstract: The research aims to study the control effect of some vinegar types available in the local market (apple cider vinegar, white vinegar, dates vinegar, and grape vinegar) at 4-6% acetic acid and 3 pH on the sensory and chemical characteristics of the aged chicken meat during two different periods (4 and 8 hours). The treatment of soaking (thigh and breast) for aged chicken meat with different types of vinegar for a period of 4, 8 hours has led to a significant improvement in the characteristics of tenderness, color, flavor, and palatability of the meat. There was a significant decrease in the juiciness of the meat and percentage of loss decreases whenever the soaking process exceeds 4 hours. Furthermore, the treatment of soaking the thigh and breast for aged chicken meat with different types of vinegar for a period of 4, 8 hours also led to a significant increase in protein, lipid and ash, and a significant decrease in moisture whenever the period of soaking exceeds 4 hours. It can be concluded that it is possible to improve the sensory and chemical characteristics of aged chicken meat when soaked with vinegar for a period not exceeding four hours and best vinegar used to improve these characteristics is grape vinegar.

Keywords: Apple cider vinegar, White vinegar, dates vinegar, Grape vinegar, Flavour, Chicken

There is a close relationship between human food and health for physical fitness, gain strong immunity against diseases by eating balanced and integrated food that contains all the nutrients. Among the most important healthy nutrients are meat is an important source of proteins that contain essential amino acids and a large group of vitamins, especially the B group, as well as containing important minerals such as zinc, iron, and phosphorous. Despite all these benefits the consumers lack of knowledge about the correct ways to make it palatable and more tenderness. The annually marketed in the world is of 250 million aged chickens (1.5 years old) and there are 2.6 billion chickens that are spent and not used for human consumption (Navid et al 2011). This type of chicken is not desirable by consumers due to the lack of tenderness of its meat because of aging, due to the high percentage of lipid and low protein. The low water holding capacity in meat leads to the low moisture content and a change in the nature of collagen and the connective tissues, so the meat is dry with fibrous textures. There are many ways to improve the sensory characteristics of aged chicken meat and increase tenderness. This emphasized decrease in the pH of meat after slaughter leads to increase the denaturation of muscular proteins and increased its tenderness. The anaerobic decomposition of glycogen leads to an increase in pyruvic acid release, increase in the activity and release of cathepsins enzymes that degrade protein synthesis and decrease pH (Lawrie 1998). Many techniques are used to improve the

characteristics of meat, especially the characteristic of tenderness, because of the economic returns for producers and consumers (Solomon et al 2008). Among these techniques, mechanical tenderization and electrical stimulation were also observed to be effective (Hopkins et al 2006). The use of the ageing technique was also used widely where the meat is cooked at a temperature (2°C) for a period of 10 - 14 days, but main drawbacks is economics. It also needs large storage areas and may lead to oxidation of lipid and change the meat colour and may increase in microbial growth. The other techniques include use of plant enzymes, such as the enzymes papain (bromelain and ficin). However, all techniques are not widely accepted due to high cost and inefficiency or may affect some of the quality characteristics of meat. Thus study aims to find the best suitable solutions to improve the quality characteristics of meat by studying the effect of different types of vinegar on the sensory and chemical characteristics of the aged chicken meat for different periods.

MATERIAL AND METHODS

Thirty-six chickens were taken from a commercial herd of laying hens from the strain ISA-Brown of age 1.5-year-old with an average weight of 1.8-2 kg. The chickens were slaughtered and placed under the heat stress for two minutes at a temperature of 54°C, where the feathers were removed and the internal organs were removed. Then, the carcasses were washed with water and left in cold water at a

temperature of 4-5°C for 2.5 hours, then they were cut, the thighs and breast pieces were taken as the main pieces in the research treatments, and the rest of the secondary pieces were neglected. The samples were distributed to nine groups, each group containing the same amount of (thigh and breast) meat in a homogeneous manner, where four groups were soaked in plastic pots with apple cider, grape, date and white vinegar, respectively, at a concentration of 4-5% acetic acid and pH = 3. Therefore, the level of the vinegar solution covered the surface of the samples for a period 4 hours at the temperature of the refrigerator, and the other four groups were treated with the same first treatment, but they were soaked for a period 8 hours, while the ninth group was not soaked with vinegar and used as a control sample.

Sensory evaluation: The sensory evaluation was performed according to the Vessely method (Vessely 1973) by taking slices of meat with a size of 2 cm³ and cooked in the electric oven at a temperature of (177°C), when the internal meat temperature reached 80 °C it was reduced for the purpose of conducting the sensory evaluation using the multi-sample test method. A large number of samples can be compared with the standard sample in this test to detect slight difference between the samples and also give additional information about the relationship between the different samples (Saad et al 2011). The assessment was conducted by 6 experienced evaluation staff for sensory parameters (tenderness, flavor, juiciness, color, and palatability) according to the estimates shown in Table 1.

Chemical analysis: Ten pieces were taken from each treatment (five pieces of thighs and five half-cut breasts), and separated the meat from the bone and minced the meat and filled in nylon bags and keeping them frozen (-18°C) until chemical analyses are performed was done which include estimating the percentage of protein, lipid, the moisture content and ash. The protein ratio was estimated according to AOAC (1990) and the lipid percentage, ash and moisture according AOAC (1984) by using the Soxhlet and petroleum ether.

Statistical analysis: The analysis of variance method was used for significant differences between the treatments, after with Duncan new multiple range tests with statistical program

statistical package for the social sciences SPSS (Saad et al 2011).

RESULTS AND DISCUSSION

Sensory evaluation: There was an increase in the tenderness of the aged chicken thigh meat with a significant difference from 2.1 in control to 3.1, 3, 3.2 and 3.5 after four hours of soaking it with white vinegar, dates vinegar, apple cider vinegar and grape vinegar, respectively (Fig. 1). The tenderness of the aged chicken breast meat increased from 2.3 in control to 2.8, and 3.3 after soaking in vinegar types with significant differences (Fig. 2). There was decrease in the juiciness from 3.4 in the control to 2.8 - 3.2 after soaking chicken thigh meat with vinegar types. In addition, a decrease in the sensory evaluation score from 3.2 in control to 2.85-3.1 after soaking the aged chicken breast meat with vinegar with significant differences (Fig. 2).

The differences in the color of aged chicken thigh meat were significant as the sensory evaluation score increased from 2.6 in the control to 3.2, 3.6, 3.7, and 3.8. after soaking the aged chicken thigh meat with white, grape, apple cider and date vinegar, respectively (Fig. 1). The differences in the color evaluation of the aged chicken breast were significant as sensory evaluation score increased from 2 in the control to 2.9-3.5 in treated one (Fig. 2). There was an improvement in the flavor of the aged chicken thigh meat after soaked it

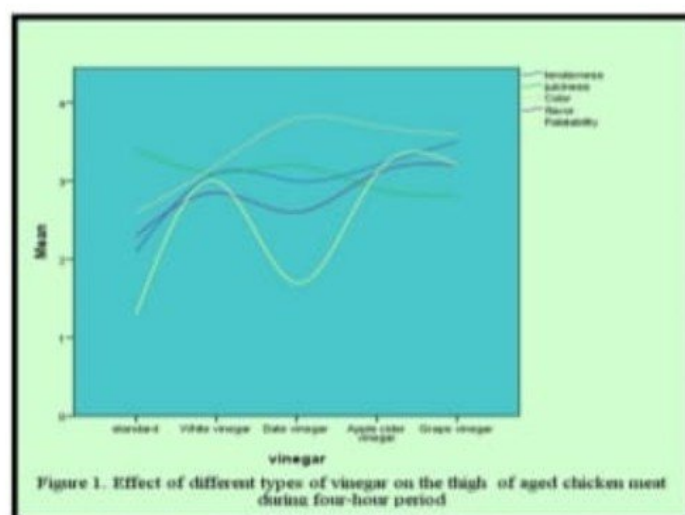


Figure 1. Effect of different types of vinegar on the thigh of aged chicken meat during four-hour period

Table 1. Sensory evaluation estimates used in the evaluation of sensory tests

Value	Tenderness	Juiciness	Color	Flavor	Palatability
1	Un tenderness	Very dry	Very light brown	Very undesirable flavor	Very unpalatable
2	Less tenderness	Dry	Light brown	Undesirable flavor	Unpalatable
3	Medium tenderness	Medium	Medium brown	Medium flavor	Medium palatability
4	Tenderness	Juicy	Dark brown	Desirable flavor	Palatable
5	Very tenderness	Very juicy	Very dark brown	Very desirable flavor	Very palatable

with different types of vinegar and the sensory evaluation score increased from 2.3 in the control sample to 2.6-3.2 after soaking as (Fig. 1). There was also an improvement in the flavor of the aged chicken breast meat after soaked with different types of vinegar and the differences were significant sensory evaluation score increased from 2.2 in the control sample to 2.7-, 3.3 after soaking the aged chicken breast meat with vinegar types. The palatability characteristic also shown the same trend.

The meat tenderness has improved with a significant difference with an increase in the sensory evaluation score from 2.1 in the control sample to 3.1, 3.3, 3.4 and 3.7 after soaking with dates vinegar, white vinegar, apple cider vinegar, grape vinegar (Table 3, Fig. 3). Furthermore, the tenderness of the aged chicken breast meat increased from 2.3 in the control to 3-3.5 after soaked the aged chicken breast meat with vinegar types with significant differences (Fig. 4). The juiciness decrease from 3.4 in the control to 2.5, 2.7, 2.9, 3 after soaked the aged chicken thigh meat with vinegar types grape vinegar, apple cider vinegar, white vinegar, and dates vinegar), respectively (Fig. 3). Besides, a decrease in the sensory evaluation score from 3.2 in the control sample to 2.4, 2.6, 2.8, 2.9 after soaking breast meat with vinegar types with significant differences. The differences in the color of the aged chicken thigh meat were significant as the sensory evaluation score increased from 2.6 in the control sample to 3.4, 3.8, 3.9, and 4 after soaking

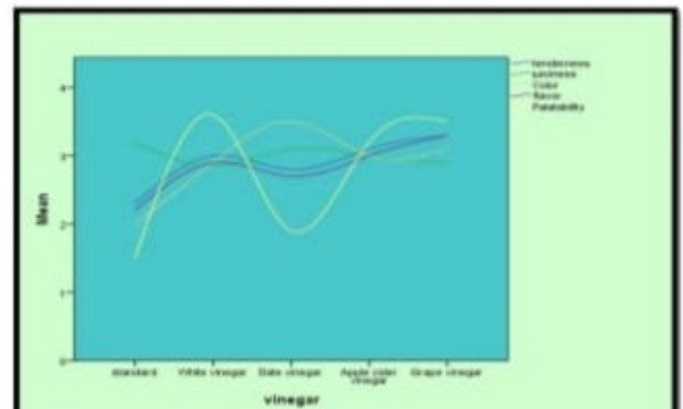


Figure 2. Effect of different types of vinegar on the breast of aged chicken meat during four-hour period

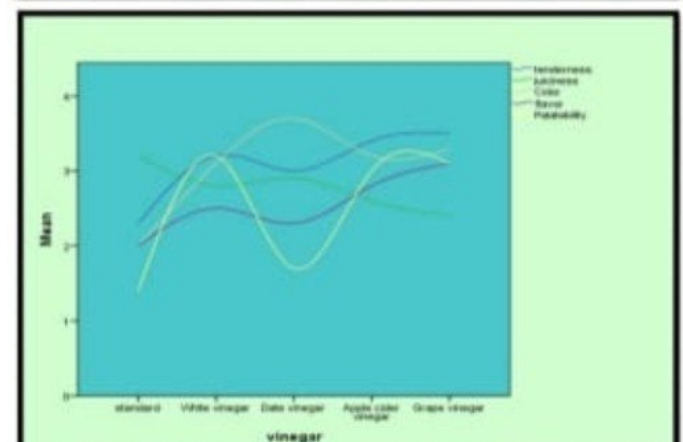


Figure 4. Effect of different types of vinegar on the breast of aged chicken meat during eight hours period

Table 2. Effect of different types of vinegar on the sensory evaluation of thigh and breast for aged chicken meat during four hours period

Vinegar	Tenderness		Juiciness		Color		Flavor		Palatability	
	Thigh piece	Breast piece	Thigh piece	Breast piece	Thigh piece	Breast piece	Thigh piece	Breast piece	Thigh piece	Breast piece
Apple cider	3.2	3.1	2.9	3	3.7	3	3.1	3	3.1	3.2
Grape	3.5	3.3	2.8	2.9	3.6	3.1	3.2	3.3	3.2	3.5
Date	3	2.8	3.2	3.1	3.8	3.5	2.6	2.7	1.7	1.9
White	3.1	3	3.1	2.85	3.2	2.9	2.85	2.9	3	3.6
Control	2.1	2.3	3.4	3.2	2.6	2	2.3	2.2	1.3	1.5

Table 3. Effect of different types of vinegar on the sensory characteristics of (thigh and breast) for aged chicken meat during eight hours period

Vinegar	Tenderness		Juiciness		Color		Flavor		Palatability	
	Thigh piece	Breast piece	Thigh piece	Breast piece	Thigh piece	Breast piece	Thigh piece	Breast piece	Thigh piece	Breast piece
Apple cider	3.4	3.4	2.7	2.6	3.9	3.2	2.9	2.8	2.9	3
Grape	3.7	3.5	2.5	2.4	3.8	3.3	3	3.1	3	3.1
Date	3.1	3	3	2.9	4	3.7	2.2	2.3	1.6	1.7
White	3.3	3.2	2.9	2.8	3.4	3.1	2.4	2.5	2.7	3.2
Control	2.1	2.3	3.4	3.2	2.6	2	2.1	2	1.3	1.4

thigh meat with white vinegar, grape vinegar, apple cider vinegar and dates vinegar, respectively. The differences in the color evaluation of the aged chicken breast meat were significant where the sensory evaluation score increased from 2 in the control to 3.1, 3.2, 3.3, and 3.7 respectively. Moreover, there was an improvement in the flavor of thigh meat after soaking with different types of vinegar and the differences were significant. There was an improvement in the flavor of aged chicken breast meat after soaking with different types of vinegar, where the sensory evaluation score increased from 2 in control to 2.3, 2.5, 2.8, 3.1 after soaked breast meat with vinegar types dates vinegar, white vinegar, grape vinegar, white vinegar, respectively.

In the palatability characteristic, the increase in the evaluation score was from 1.3 in the control sample to 1.6, 2.7, 2.9, 3 after soaked the aged chicken thigh meat with the types of vinegar dates vinegar, white vinegar, apple cider vinegar, grape vinegar, respectively with a significant difference. The palatability of the aged chicken breast meat increase from 1.5 in the control sample to 1.7, 3.1, 3, 3.2 after soaked breast meat with vinegar types dates vinegar, white vinegar, apple cider vinegar, grape vinegar, respectively, with a significant difference.

Effect of soaking with different types of vinegar on the chemical characteristics of aged chicken meat: The effect of soaking the aged chicken thigh meat with different types of vinegar for a period of four hours reduced the moisture content from 64.92 in the control to 64.3- 64.75 after

soaking thigh meat with vinegar types with significant difference (Table 4). In contrast, the percentage of solids has increased to 18.06, 18.1, 17.92, 17.85 ; 12.2, 12.3, 12.01, 12.1 and 4.1, 4, 4.02, 4.2 after soaked thigh meat with Apple cider, grape, dates an d, white vinegar ,respective as compared to control sample, where protein, lipid, and ash was 17.80, 12 and 3.9. Similarly during soaking the aged chicken breast meat with different types of vinegar for a period of four hours has led to decrease the moisture content from 66.8 in the control sample to (66.4- 66.68) after soaked the aged chicken breast meat vinegar types with significant difference. Besides, the percentage of solids increased more than they were in the control sample, where protein, lipid and ash percentage 18.85, 8.82, 4 increased to 19.13, 19.22, 19.10, 18.92; 9.1, 9.2, 8.9, 9 and 4.2, 4.32, 4.21, 4.4 after soaking breast meat with apple cider, grape, date and white vinegar, respectively.

The soaking (thigh and breast) for aged chicken meat with different types of vinegar and for a period of eight hours has led to a decrease in the moisture content from 64.92 in the control sample to 64.3 - 64.5 percent with vinegar types with significant differences (Table 5). In contrast, the percentage of solids has increased, where protein, lipid, and ash percentage increased to 18.2, 18.32, 18, 17.97; 12.3, 12.22, 12.1, 12.4 and 4.14, 4, 4.1, 4.31 after soaked the aged chicken thigh meat with apple cider vinegar, grape vinegar, dates vinegar, white vinegar, respectively as compared with control being 17.80, 12.0 and 3.9. Similarly, soaking the

Table 4. Effect of different types of vinegar on the chemical characteristics (thigh and breast) for aged chicken meat during soaking period of four hours (%)

Vinegar	Protein		Fat		Moisture		Ash	
	Thigh piece	Breast piece	Thigh piece	Breast piece	Thigh piece	Breast piece	Thigh piece	Breast piece
Apple cider	18.06	19.13	12.2	9.1	64.54	66.4	4.1	4.2
Grape	18.1	19.22	12.3	9.2	64.3	66.28	4	4.32
Date	17.92	19.10	12.01	8.9	64.75	66.68	4.02	4.21
White	17.85	18.92	12.1	9	64.61	66.53	4.2	4.4
Control	17.80	18.85	12	8.82	64.92	66.8	3.9	4

Table 5. Effect of different types of vinegar on the chemical characteristics (thigh and breast) for aged chicken meat during soaking period of eight hours (%)

Vinegar	Protein		Fat		Moisture		Ash	
	Thigh piece	Breast piece	Thigh piece	Breast piece	Thigh piece	Breast piece	Thigh piece	Breast piece
Apple cider	18.2	19.1	12.3	9.2	64.11	66.1	4.14	4.38
Grape	18.32	19.14	12.22	9.4	63.97	65.85	4	4.18
Date	18	18.87	12.1	9	64.5	66.5	4.1	4.3
White	17.97	18.86	12.3	9.08	64.3	66.25	4.31	4.5
Control	17.80	18.85	12	8.82	64.92	66.8	3.9	4

aged chicken breast meat with different types of vinegar for a period of four hours has led to decrease the moisture content from (66.8 in the control sample to 66.1- 66.85 after soaking breast meat with vinegar types by significant differences. Finally, the percentage of solids increased more than they were in the control sample, where protein, lipid, and ash percentage increased from 18.85, 8.82 and 4 in control samples to 19.1, 18.86, 18.87, 19.14; 9.2, 9.08, 9, 9.4 and 4.38, 4.31, 4.3, 4.5 after soaked the aged chicken breast meat with apple cider vinegar, grape vinegar, date vinegar, white vinegar, respectively.

The treatment of aged chicken meat resulted in significant differences in the water holding capacity in the meat between different treatments and for different periods (4, 8 hours), where the highest value of moisture content was recorded after soaked (thigh and breast) for aged chicken meat with white vinegar. The lowest moisture content after soaked (thigh and breast) for aged chicken meat with apple cider vinegar. This may be due to the fact that vinegar works to stabilize the cellular membrane of the meat and inhibit the formation of free radicals by preventing the transfer of the hydrogen atom to the free root. Therefore, these roots become stable and reflected in improving the water holding capacity in meat, as maintaining the integrity of the membranes of the meat cells from rupture contributes effectively maintaining meat components. Thus play role in the water holding capacity and drip loss (Hauk and Ramadan 2001). Similarly, the high acid level in vinegar leads to protein denaturation and thus leads to protein loss, physical properties and a loss of its water holding capacity. Therefore, there were significant differences in increasing the meat tenderness (thigh and breast) for aged chicken by treating with vinegar. The meat tenderness depends on the degree of protein binding with water and the amount of lipid present in it and the amount of tissue that connects the muscles. Furthermore, the high percentage of lipid (thigh and chest) of the aged chicken was showed a significant difference, where the highest value of the lipid percentage was recorded after soaking aged chicken meat with grape vinegar for a period of four hours. The lowest lipid percentage after soaking the thigh and breast for aged chicken meat with apple cider vinegar for a period of four hours. The high lipid percentage improves meat tenderness by stimulating salivary glands to secrete saliva and the lipid accumulates under the skin and thus prevents the loss of more moisture and thus maintains the meat's moisture and its tenderness (Saad et al 2011).

Moreover there was significant decrease in the juiciness of the thigh and breast of the aged chicken meat after soaking with different types of vinegar. The juiciness depends on the moisture content of meat and the moisture also recorded a significant decrease as mentioned above. Significant differences were recorded in improving the palatability and flavor of the aged chicken meat after soaking with different types of vinegar for a period of 4 and 8 hours. The best value of flavor was recorded after soaked the thigh and breast of the aged chicken meat with grape vinegar for four hours. The best value for palatability was recorded after soaked the thigh and breast of the aged chicken meat with grape vinegar for a period of four hours. For meat color, the highest value was after soaked with date vinegar for a period of eight hours, where the dark brown color was observed which comes as a result of the presence of caramel tincture in vinegar.

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