Original Article

THE EFFECT OF USING DIFFERENT LEVELS OF CINNAMON OIL AND GINGER OIL ON SOME QUALITY, PHYSICAL CHARACTERISTICS OF LOCAL GOOSE MEAT STORED BY FREEZING FOR DIFFERENT PERIOD

Najla Danyar Abdl Wahab ALrdwany[1], Adnan Shakor Ahmed Al-Perkhdri[2]
[1]College of Agriculture, University of Kirkuk, Kirkuk, Iraq
[2]Public Health, College of Veterinary Medicine, University of Kirkuk, Iraq.
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Abstract

This study was conducted on 10/12/2021 until 15/11/2021 in the Graduate Studies Laboratory of the College of Agriculture, Kirkuk University / Department of Animal Production. In order to study the effect of using medicinal plant oils on some physical characteristics of thigh and breast meat for local frozen almonds for different periods at a temperature of -18°C, the meat was minced separately from the thigh and the breast, and the meat was mixed and naturalized. Then it was divided into five treatments, the first treatment (1) was considered the control treatment, as it was not treated with any additives, while cinnamon oil was added at a concentration of (0.25 ml/kg of meat) to the second treatment (T2), and cinnamon oil was added at a concentration of (0.5 ml/kg of meat)) to the third treatment (T3), adding ginger oil at a concentration (0.25 ml/kg of meat) to the fourth treatment (T4), and adding ginger oil at a concentration (0.5 ml/kg of meat) to the fifth treatment (T5). And three replicates for each of the thigh and chest for each period, and were stored by freezing at a temperature of (-18) ° C for periods of 1, 15 and 30 days until physical examinations were performed. The study reached the following results: The treatment of adding cinnamon oil and ginger oil recorded the lowest percentage of loss during thawing and loss during cooking, with an improvement in the ability of meat to carry water when stored in freezing . As for the interaction between treatments and the effect of storage period and treatment effect, we note that there are significant ($P<0.05$) differences in all study treatments compared with the control treatment. As for the effect of freezing storage periods, the results were: Increasing the storage period led to an increase in the percentage of loss during thawing and loss during cooking and a significant decrease in water carrying capacity.

Keywords: goose meat, ginger, cinnamon, freezing.

INTRODUCTION

The great interest for researchers in recent herbal medical through the purification of its components effective,(Al-perkhdri and Muhammed , 2020)) .The goose is one of the waterfowl that is found in abundance in the world and in Iraq it is found in the southern region, which is characterized by its high production of meat and eggs. (Bessei and Nyword ,2002) , as its meat represents 6% of the total poultry meat production in the world, and it is one of the most important economically important poultry in the world due to the increasing demand by consumers for its meat at the present time being rich in proteins, which is characterized by a high biological value and rich With essential amino acids and fats as well as being a source. For vitamins B-Complex, A and C, and minerals such as calcium, magnesium, and phosphorous (Boz et al., 2019). Poultry consumers expect that high-quality meat is obtained from birds raised under natural environmental conditions, as they consider products with health-promoting properties and original taste to those that come from less prevalent species, so meat obtained from Goose This expectation of obtaining health benefits, not only meat, as well as its by-products are also used as protein concentrates (Utnik - Banas and Zmija., 2018). Because of the chemical and biological nature of meat and its products, they are subjected to damage during the storage period, and the damage is either chemical or microbial, which are the main factors affecting the quality of food and reducing its vitality, as it negatively affects the taste, flavor and texture, which leads to a short shelf life of meat and its products (Nychas et al., Ravyts; 2008 et al., 2012; Yolmeh et al., 2014). Several studies have been conducted to find ways to increase the shelf life of meat, and one of these methods is the addition of some materials that help preserve meat, which may be chemically manufactured, plant extracts, organic acids or essential oils (Vatanser and Gulmez, 2006). The addition of

some industrial materials such as sorbic, salicylic and benzoic acid and some salts such as nitrates and nitrites in the food industry are among the other causes that cause diseases, especially cancerous diseases .(Al-Janabi, 2004). These natural additives have proven to be effective and capable of reducing the effects of oxidative rancidity, delaying the development of undesirable flavors and improving the stability and coloring of meat. Therefore, researchers are increasingly interested in studying the properties of these natural additives (Hygreeav et al., 2014). Among these highly effective natural additives as anti-oxidants can use in storage of broiler (Al- perkhdri et al, 2020) . anti-bacterials that can be added to meat and meat products are cinnamon oil and ginger oil because of their effective and antioxidant compounds, microbes, parasites and fungi (lmelouane et al., 2009). Therefore, plants are considered one of the important and alternative sources of many compounds due to their high effectiveness, cheapness and high production. From this logic, the current study on the oils of some plants aims to highlight their nutritional importance in preserving meat. Therefore, the aim of this study is: Study of the effect of different concentrations of cinnamon oil and ginger oil on the physical characteristics of goose meat stored in freezing for 30 days.

Materials and methods of work

This research was conducted in the Graduate Studies Laboratory of the College of Agriculture, Kirkuk University, Department of Animal Production. For the period from 10/12/2021 until 15/11/2021

Experiment parameters

T1- control without any additives

T2- Cinnamon oil 0.025% or 0.25% ml/kg meat

T3- Cinnamon oil 0.05% or 0.5% ml/kg meat

T4- ginger oil 0.025% or 0.25% ml/kg meat

T5- ginger oil 0.05% or 0.5% ml/kg meat

Physical examination of the meat

First - measuring the percentage of loss during thawing

The percentage of loss during thawing of meat was measured based on the method of Nam et al., (2000), as 50 gm of frozen meat samples were taken from each treatment after recording the weight accurately and placing it in a transparent nylon bag. The bags were placed inside the refrigerator at a temperature of 4 ° C for 24 hours. Re-weigh the samples after drying them and removing liquids from the surface of the meat samples using filter papers. The percentage of loss during defrost was calculated according to the following equation .

$$\text{Loss during melting} = \frac{\text{Weight of frozen meat - weight of meat after thawing}}{\text{frozen meat weight}} \times 100$$

Loss Cooking Measurement

The percentage of loss during cooking was measured according to the method (Ahmet and Mustafa, 2018) by taking 50 g of meat after accurately recording the weight and placing it in a cooking bag (transparent nylon), closing it tightly, then placing the bags in the electric oven at 180 ° C for a period of time. 30 minutes after that, the bags were left with the meat inside to

cool, then the samples were weighed after removing the liquid on the surface of the model with filter paper, and the percentage of loss was calculated as follows .

$$\text{Cooking loss} = \frac{\text{Weighing meat before cooking - Weighing meat after cookin}}{\text{Weight of meat after cooking}} \times 100$$

Third - Water Holding Capacity (WHC)

The method of Dolatowski and Stasiak 1998) was followed in measuring the water carrying capacity (WHC) by taking 50 g of meat for each treatment, mixed and mashed with 50 ml of distilled water for one minute using an electric mixer, then discarding the homogenized mixture in a centrifugal device at a speed (5000 rpm/min). for 10 minutes). The percentage of water carrying capacity was calculated as follows

$$\text{Water carrying capacity (\%)} = \frac{\text{Weight of water after centrifugation - weight of water added to meat}}{\text{model weight}} \times 100$$

Statistical analysis

The results were statistically analyzed using the complete random design (CRD) to study the effect of treatment and period on different traits, and the significant differences between the means were compared with Duncan's, 1955 polynomial test. According to the mathematical model:

Mathematical model:

$$Yijk= \mu + Ti+ Pj+TP (ij)+eijk$$

Results and discussion:

Physical examination of thigh meat and chest of local goose meat

Thaw loss estimation

Estimation of the percentage of loss during thawing Table (1) shows the effect of the interaction between different treatments and storage periods on the percentage of loss during thawing of thigh and breast meat for local almonds stored in freezing for periods (1, 15, 30) days. It is noted that there are significant differences (P≤0.05) in the percentage of loss During thawing for breast and thigh meat treated with different concentrations of cinnamon oil and ginger oil, it was found from the table that there was a significant decrease (P≤0.05) in the rate of loss during thawing for thigh meat, as the highest significant differences were recorded for the control treatment T1 without any additions during the third period of storage, which amounted to 5 ,65%. While the lowest moral difference of loss during dissolution was recorded in the first period of T5 treatment, as it reached 374.%. And there was a significant decrease (P≤0.05). In the rate of loss during dissolution for all the addition treatments compared to the control. The reason for this is due to the effect of plant additives that contain phenolic compounds that act as antioxidants, which have the ability to protect the cell wall from being destroyed by the oxidation process, which leads to an increase in the

degree of stability of the cellular structure of meat and thus reduce from the release of exudate from inside the cell, and this agrees with (Viuda-Martos et al. 2015).

It was found from Table (1) that the average of the addition treatments with cinnamon oil and ginger oil for frozen thigh meat, we note that there were significant ($P \leq 0.05$) differences in the percentage of loss during thawing, which recorded a significant decrease ($P<0.05$) in the percentage of loss during thawing compared to the control treatment, Whereas, treatment T5 and T3 recorded the least significant difference in loss, which amounted to 4.51%, compared to the control, which recorded the highest significant difference in loss during dissolution, which amounted to 5.32%. The reason for the moral decline may be due to the low percentage of meat moisture, as this trait depends largely on the moisture content of meat (Al-Shammari, 2007). and sensory for meat of aged laying hens, as the results showed a significant decrease ($P \leq 0.05$) in the loss in the exudate and the loss during defrost in samples of breast and thigh meat separately and submerged in different concentrations of saline solutions compared with the control treatment. With the study of Salem, (2011) when adding concentrations 0, 0.5, 0.75, 1, 1.25, 1.5, 1.75, 2, 2.25, 2.5, 2.75% + 0.5% spices to all treatments except for the control treatment, it found a significant decrease in the percentage of lost weight After dissolving inversely with the added percentage of ginger, its percentage recorded in the last treatment was 19.2% and 26.3% compared to the control group. The reason is due to the effect of the active substances present in ginger on the treatments. Added (Salem, 2011). In the study of Baha Al-Din, (2012) the effect of ginger roots, watermelon seeds and fig leaves on some sensory and biochemical characteristics of aged chicken meat, as the addition treatments recorded a decrease in the percentage of weight loss during dissolution when using ginger root powder with different concentrations for meat samples (breast and thigh) compared to the control treatment.

With regard to the effect of the storage period on the percentage of loss during thawing, the results showed a significant effect ($P<0.05$)) for the storage period, as the percentage of loss was at its lowest level in the first period, which amounted to 4.50% and then began to rise with the progress of the storage period until it reached its highest level in The third period of 30 days amounted to 4.88%. The reason for this may be due to the decomposition of meat proteins by the action of hydrolytic enzymes, which are responsible for some subtle changes in the permeability of cell membranes and the decrease in water bound to the protein accordingly, and consequently the percentage of loss increases (AL-Rubeii and Muhammad, 2018). This agreed with what Al-perkhri (2014) found when using cinnamon and its water and oily extract in minced veal meat and stored in freezing for different periods (1, 30, 60), where the lowest percentage of loss during thawing was recorded during the first period of storage and then began to increase with the progression of the period Storage until it reached its highest level during the third period.

Table (1) showed the effect of the interaction between different treatments and storage periods in the breast meat of local almonds stored in freezing for periods (1, 15, 30) days. Cinnamon and ginger oil It was found from the table that the highest percentage of loss of breast meat was for T1 treatment (without any additives) amounting to 6.02% during the third period of preservation of 30 days. While the lowest percentage of loss in breast meat was for the treatment T5(ginger oil at a concentration of 0.5) It reached 5.13 % during the first period of storage. Also, all the addition treatments recorded a significant decrease in the percentage of loss during thawing for all storage periods compared to the control. From Table (1), it was found that the average of the treatments of addition of cinnamon oil and ginger oil to breast meat stored in freezing in the percentage of loss during thawing of breast meat, as we find in the values of the general mean significant differences ($P \leq 0.05$). The treatment recorded T5 (ginger oil at a concentration of 0.5) The lowest percentage of loss was 5.27% compared to the control treatment Which recorded the highest loss rate of 5.68% due to the effect of the storage period on the rate of loss during thawing and this is in agreement with the study of Bushra (2010) Containing the ginger solution was less compared to the control treatment and the percentages were 7.55, 7.83, 7.86, 14.07%, respectively. It also agreed with the study of Al-Alwani, (2010) in his study of the effect of some enzyme solutions and extracts on the physical, chemical, bacterial and sensory properties of meat of aged laying hens. Each individually and immersed in different concentrations of Saline solutions compared to the control treatment. of the active substances present in ginger on the added treatments. With the study of Salem, (2011) when adding concentrations 0, 0.5, 0.75, 1, 1.25, 1.5, 1.75, 2, 2.25, 2.5, 2.75% + 0.5% spices to all treatments except for the control treatment, it found a significant decrease in the percentage of lost weight After dissolving inversely with the added percentage of ginger, its percentage in the last treatment was 19.2% and 26.3% compared to the control group. The reason is due to the effect With the study of Bahaa El-Din, (2012) the effect of ginger roots, watermelon seeds and fig leaves on some sensory and biochemical characteristics of aged chicken meat . Also from the mentioned table, it is clear to us that there is a significant effect ($P<0.05$) for the storage period, as the percentage of loss was at its lowest level in the period of 1 day, which amounted to 5.21%, then it began to rise with the progress of the storage period until it reached its highest level in the third period of 30 day when it reached 5.59%. The thaw loss increases when using freezing due to the mechanical damage caused by the ice crystals, which causes the muscle membranes to rupture and water to escape (Lu et al., 2019).

Table (1) The effect of the interaction between different treatments and periods of freezing storage on the percentage of loss during thawing of thigh and breast meat for local almonds stored in freezing at -18°C (mean ± standard error).

thigh meat				
Transactions	Storage periods/days			Average Transactions
	1	15	30	
T1	4.92±0.003c	5.39±0.01b	5.65±0.02a	5.32±0.10a
T2	4.42±0.008i	4.73±0.008e	4.82±0.003d	4.66±0.06b
T3	4.39±0.003	4.54±0.008h	4.59±0.008fg	4.51±0.02d
T4	4.40±0.003i	4.74±0.01e	4.76±0.008e	4.63±0.05c
T5	4.37±0.003j	4.56±0.008hg	4.61±0.008f	4.51±0.03d
average periods	4.50±0.05 c	4.79±0.08 b	4.88±0.10 a	
breast meat				
Transactions	Storage periods/days			Average Transactions
	1	15	30	
T1	5.34±0.005f	5.70±0.01b	6.02±0.01a	5.68±0.09a
T2	5.24±0.01h	5.38±0.005e	5.56±0.005c	5.39±0.04b
T3	5.20±0.005i	5.33±0.003f	5.49±0.008d	5.34±0.04c
T4	5.14±0.005j	5.35±0.003g	5.48±0.003d	5.32±0.05d
T5	5.13±0.01j	5.29±0.003g	5.39±0.01e	5.27±0.03e
average periods	5.21±0.02c	5.41±0.03b	5.59±0.06a	

Means with different letters differ significantly ($P<0.05$) among themselves.

T1 control (without addition), T2 (cinnamon 0.25 ml/kg meat), T3 (cinnamon 0.5 ml/kg meat), T4 (ginger 0.25 ml/kg meat), T5 (ginger 0.5 ml/kg meat)

Cooking loss:

Table (2) shows the effect of the interaction between different treatments and storage periods on the percentage of loss during cooking for breast and thigh meat for local almonds stored in freezing for periods (1, 15, 30) days. Factories with different concentrations of cinnamon oil and ginger oil, it was shown from the table that there were significant differences between the treatments in the rate of loss during thawing of thigh meat, as the highest significant differences were recorded for the control treatment T1 without any additions during the third period of storage amounted to 21,34%. Whereas, the least significant differences in the loss during cooking were recorded in the first period of T5 treatment (ginger oil at a concentration of 0.5), which amounted to 20.25 %. Also, different significant differences were recorded between the treatments and for all the different storage periods. The decrease in the percentage of loss during cooking is due to the low percentage of moisture due to the evaporation of the water on the surface of the meat and the decomposition of meat proteins through enzymes that break the bonds that bind protein with water and thus be subject to evaporation (Juarez et al., 2010).

It was shown from Table (2) that the average of the addition treatments with cinnamon oil and ginger oil to the frozen thigh meat. We note that there were significant differences ($P\leq0.05$) in the percentage of loss during cooking, which recorded a significant decrease ($P<0.05$)) in the percentage of loss during cooking compared to the control treatment. The treatment T5 recorded the least significant differences in the loss during cooking, which amounted to 20.40%, compared to the control, which recorded the highest significant differences in the loss during cooking, amounting to 21.00%. This is in agreement with the study of Al-Alwani, (2010) in his study of the effect of some solutions and extracts The results showed a significant decrease ($P\leq0.05$) in the percentage of waste during cooking in samples of breast and thigh meat individually and immersed in different concentrations of brine solutions compared to the control treatment.

Regarding the effect of the storage period on the percentage of loss during cooking, the results showed a significant effect ($P<0.05$)) for the storage period, as the percentage of loss was at its lowest level in the first period, which amounted to 20,33%, and then began to rise with the progress of the storage period until it reached its highest level in The third period of 30 days amounted to 20.83%. The significant decrease in this trait may be due to a decrease in the moisture content of the meat because this characteristic is greatly affected by the moisture content of the meat (Al-Shammari, 2007).

Table (2) showed the effect of the interaction between different treatments and storage periods on the percentage of loss during cooking for breast meat. Significant (P≤0.05) in the percentage of loss during thawing of breast meat, as the highest percentage of the control treatment T1 without any additions was recorded, which amounted to 22.28% during the third period of preservation of 30 days. While the lowest percentage of loss during cooking was recorded during the period The first treatment for T3 (cinnamon oil at a concentration of 0.5) was 21.04%. It was followed by treatment T5 (ginger oil at a concentration of 0.5) which amounted to 21.05%. . The decrease in the percentage of loss during cooking is due to the low percentage of moisture due to the evaporation of the water on the surface of the meat and the decomposition of meat proteins through enzymes that break the bonds that bind protein with water and thus be subject to evaporation (Juarez et al., 2010). It was shown from Table (2) that the average treatments of addition of cinnamon oil and ginger oil to the frozen breast meat stored. We note that there are significant differences (P≤0.05) in the percentage of loss during cooking, which recorded a significant decrease (P<0.05)) in the percentage of loss during cooking compared to the control treatment. Whereas, the treatment T5 recorded the lowest rate of loss, amounting to 21.19%, compared to the control, which recorded the highest percentage of loss during cooking, which amounted to 21.77%. This is in agreement with the study of Bushra, (2010) when treating the aged chicken breast with ginger powder at a concentration of 5,3,1,0 % decrease Significant (P<0.05) in the percentage of loss during cooking of chicken breast samples treated with 0%, g 1%, g 3% and g 5% of ginger solution compared to 0%. As for the effect of the storage period on the percentage of loss during cooking for breast meat, the results showed a significant effect (P<0.05)) for the storage period, as the percentage of loss was at its lowest level in the period of 1 day, amounting to 21.11%, then it started to rise with the progress of the storage period until it reached Its highest level was in the third period of 30 days, reaching 21.57%. The reason for the increase in the percentage of loss during storage may be attributed to the formation of ice crystals upon freezing and the thawing of these crystals and their loss in the form of water drops during meat thawing and cooking (AL-Owaimer, 2006; Youssef, 2014) . It agreed with the study of Bahaa El-Din, (2012) in his study of the effect of ginger roots, watermelon seeds and fig leaves on some sensory and biochemical characteristics of aged chicken meat that treating chicken meat pieces with different concentrations of powder Ginger root led to an increase in meat weight during cooking compared to the control treatment.

Table (2) The effect of the interaction between different treatments and periods of freezing storage on the percentage of loss during cooking of thigh and breast meat for local almonds stored in freezing at -18°C (mean ± standard error).

thigh meat				
Transactions	Storage periods/days			Average Transactions
	1	15	30	
T1	20.56±0.008g	21.10±0.02b	21.34±0.01a	a21.00 ±0.11
T2	20.31±0.003i	20.78±0.01e	20.85±0.02c	b20.65 ±0.08
T3	20.26±0.01j	20.54±0.005g	20.60±0.005f	c20.47 ±0.05
T4	20.29±0.003i	20.82±0.01d	20.87±0.005c	b20.66 ±0.09
T5	20.25±0.002j	20.47±0.005h	20.48±0.003h	d20.40 ±0.03
average periods	0.0320.33± c	0.06`20.74± b	20.83±0.07 a	
breast meat				
Transactions	Storage periods/days			Average Transactions
	1	15	30	
T1	0.00321.20±h	b21.85±0.008	22.28±0.01a	a21.77 ±0.15
T2	0.00321.11± j	0.00521.39±d	21.51±0.005c	b21.33 ±0.05
T3	0.00821.04±k	0.00321.27±f	21.36±0.003e	d21.22 ±0.04
T4	0.0221.15±i	0.00521.36±e	21.41±0.008d	c21.30±0.04
T5	k21.05 ±0.001	g21.24 ±0.008	21.28±0.008f	e21.19 ±0.03
average periods	21.11±0.01c	21.42±0.05b	21.57±0.09a	

Means with different letters differ significantly (P<0.05) among themselves.

T1 control (without addition), T2 (cinnamon 0.25 ml/kg meat), T3 (cinnamon 0.5 ml/kg meat), T4 (ginger 0.25 ml/kg meat), T5 (ginger 0.5 ml/kg meat))

Water Holding Capacity:

Table (3) shows the effect of the interaction between different treatments and storage periods in estimating the water-carrying capacity of meat for breast and thigh meat for local almonds stored in freezing for periods (1, 15, 30) days. For breast and thigh meat treated with different concentrations of cinnamon oil and ginger oil, it was found from the table that there was a significant increase (P≤0.05) in the meat's ability to carry water for thigh meat, as the highest significant differences were recorded for T3 treatment (cinnamon oil at a concentration of 0.5) during the first period Of the storage amounted to 50,39% when compared with the control treatment. Whereas, the least significant differences were recorded for meat susceptibility On the water load, it was in the third period of preservation for T1 treatment that it amounted to 49.54%. Also, significant differences were recorded between the treatments and for all the different storage periods. The reason may be that the natural additives maintain the stability of meat proteins (myofibrillal proteins) from breaking down, which increases the water-carrying capacity of these proteins (Al-Alwani, 2017).

It was shown from Table (3) that the average of the addition treatments with cinnamon oil and ginger oil to the frozen thigh meat. We note that there were significant (P≤0.05) differences in the ability of the meat to carry water for the thigh meat of the local almond, as the treatment T5 recorded the highest significant difference, which amounted to 50.25 % compared to The control that recorded the lowest significant difference was 49,89%. The reason may also be due to the active compounds that these treatments contain, which has the ability to protect the cell membrane from breaking down, thus protecting proteins from decomposition and preventing water from leaving the outside and remaining attached to the protein (Mohammed, 2018).

With regard to the effect of the storage period on the ability of meat to carry water, the results showed a significant effect (P<0.05) for the storage period, as the water carrying capacity was at its highest level in the first period, which amounted to 50,34%, then it began to decline with the progress of the storage period until it reached the lowest level In the third period of 30 days, it amounted to 49.95%. The reason for this is due to the decomposition of meat proteins with the progression of the storage period and the decrease in its ability to carry water (Al-Birkhadari, 2014).

Table (3) shows the effect of the interaction between different treatments and storage periods on the ability of meat to carry water for breast meat. A significant increase (P≤0.05) in the water carrying capacity of breast meat, as the highest percentage of T5 treatment was recorded, which amounted to 51.58% during the first period of preservation of 1 day compared to the control. While the lowest percentage of water carrying capacity was recorded in the third period of T1 treatment (ithout any additives), which amounted to 50.42%. Followed by the second period of the control treatment amounted to 50,64% . It was shown from Table (3) that the average of the addition treatments with cinnamon oil and ginger oil to the frozen breast meat. We note that there were significant differences (P≤0.05) in the water-carrying capacity of the meat, which recorded a significant increase (P<0.05)) in the water-carrying capacity of the breast meat. Compared to the control treatment, treatment T5 recorded the highest water carrying capacity of 51.39% compared to the control that recorded the lowest water carrying capacity of 50.74% . As for the effect of the storage period, the water carrying capacity of breast meat, the results showed a significant effect (P<0.05)) for the storage period, as the water carrying capacity was at its highest level in the period of 1 day, amounting to 51.43%, then it began to decline with the progress of the storage period until it reached less Its level in the third 30-day period reached 50.98%. The reason is due to the increase in the ability of meat to carry water as a result of the association of water with proteins within the muscles due to the increase in ionic strength, thus achieving a direct relationship between the ability of meat to carry water and its high pH(Viuda-Martos , 2015) . These results are in agreement with what was found by Naveena and Mendiratta (2001), Pawer et al. (2009), Al-Alwani (2010), Naveena (2004), With Baha Al-Din (2010).

Table (3): The effect of the interaction between the different treatments and the periods of freezing storage in estimating the water carrying capacity of thigh and breast meat for local almonds stored in freezing at -18°C (mean ± standard error).

thigh meat				
Transactions	Storage periods/days			Average Transactions
	1	15	30	
T1	50.23±0.005c	49.91±0.005i	49.54±0.005j	E 49.89 ±0.09
T2	50.35±0.003b	50.09±0.01f	49.95±0.01h	D 50.13 ±0.05
T3	a50.39 ±0.008	50.17±0.008e	50.08±0.008f	B 50.21 ±0.04
T4	50.35±0.008b	50.08±0.003f	50.01±0.003g	C 50.15 ±0.05
T5	50.39±0.003a	50.20±0.005d	50.16±0.003e	A 50.25 ±0.03
average periods	0.0150.34±a	0.0250.09±b	0.0549.95±c	
breast meat				

Transactions	Storage periods/days			Average Transactions
	1	15	30	
T1	0.00551.18± g	0.00850.64±i	0.00550.42±m	E 50.74 ±0.11
T2	0.00551.42± d	0.0151.04± j	K 50.97 ±0.005	D 51.14 ±0.07
T3	0.00551.47±c	0.00851.23±f	0.0151.14±h	B 51.28 ±0.04
T4	b51.53 ±0.01	0.00351.14±h	0.00551.10±i	C 51.25 ±0.06
T5	a51.58 ±0.005	51.31e±0.008	e51.29 ±0.003	A 51.39 ±0.04
average periods	51.43±0.03a	51.07±0.06b	50.98±0.08c	

Means with different letters differ significantly (P<0.05) among themselves.

T1 control (without addition), T2 (cinnamon 0.25 ml/kg meat), T3 (cinnamon 0.5 ml/kg meat), T4 (ginger 0.25 ml/kg meat), T5 (ginger 0.5 ml/kg meat).

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