STABILITY OF FROZEN STORED LAMB MEAT PRODUCT TREATED BY GRAPE SEEDS EXTRACT AND PACKAGED UNDER VACUUM

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Abstract

The stability of lamb meat burgers stored frozen for 8 months was studied using proximate composition, moisture loss, total acidity, pH value, TBA value, TVN value, WHC, Expressible water, total bacterial count, and sensory evaluation. The natural antioxidant (0.1% grape seeds extract) and packaging treatment (without and with vacuum) were both added. The data showed that as storage time increased, all samples' total acidity and TBA values increased while their moisture content and pH values decreased. In comparison to the treated samples, the change was greater in the control samples. The data demonstrated that, when compared to control samples or samples packaged without vacuum, samples treated with 0.1% grape seed extract (as natural antioxidant) and packaged under vacuum had the lowest values of TBA, total bacterial count. Additionally, compared to the control, it has higher assessment ratings for overall acceptance.

Key words: *lamb meat burger, Grape seeds extract, Natural antioxidant, Vacuum packaging*

INTRODUCTION

Since it is a large source of protein, minerals, vitamins, and trace elements, meat is acknowledged as being an important ingredient of a balanced diet. The creation of novel functional meat products was motivated by research into unfavorable issues involving meat consumption and its effects on human health [5]. Meat has been an important part of human nutrition for at than a million years [12]. There are many different methods to eat meat, which comes from many animal species. It's common practice to segregate fresh meat from processed beef. Processed meat has undergone more processing than fresh meat, including salting, smoking, marinating, and heat treatment [16]. Sheep make good livestock animals because they can transform forages and unfit for human consumption feeds into meat and milk, which are crucial sources of dietary protein for people. Sheep are a crucial part of Egyptian agriculture, and the livestock sector in the country accounts for more than 30% of total agricultural output. Sheep are therefore essential to Egypt's strategy for guaranteeing its food security [6]. The most prevalent kind of chemical breakdown occurs when meat lipids are oxidized. The complex process of lipid oxidation is influenced by the chemical composition of the meat, exposure to light and oxygen, and storage temperature. While microbial multiplication has the potential to taint food and spread diseases, lipid oxidation produces unappealing organoleptic qualities. Therefore, delaying lipid oxidation and inhibiting bacterial development are two aspects that can significantly help in extending shelf life. Because of the low cost, high stability, and effectiveness of synthetic antioxidants like BHT and BHA, adding them to food has been beneficial in reducing the detrimental effects of lipid oxidation on food's color,

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flavor, texture, and nutritional value. [13] claim that the use of these compounds has been associated with health risks, which has resulted in strict restrictions on their use in food products. The search for alternative antioxidant sources has been motivated by this. Factors including exposure to oxygen, light, heated temperatures, and microorganisms can all raise the risk of lipid oxidation in lamb meat. The shelf life of lamb meat products can be extended by using packing and storage techniques such vacuum packaging, low-temperature storage, and antioxidant treatment. Lamb flesh is easily exposed to lipid oxidation because of its complex physical structure and chemical makeup, both of which make it sensitive to oxidation [24 & 21]. A good way to delay rancidity, reduce the creation of harmful chemicals, maintain nutritional content, and prolong the shelf life of fatty food products is to add antioxidants in meals that contain fat. However, because of the health risks connected with their use, they are strictly prohibited from being used in food, which has sparked research into antioxidant alternatives [13]. Processors are looking for natural solutions to preserve their products as consumer concerns about the amount of chemicals added to their food grow. In order to balance out meals high in fat, there has recently been a lot of interest in employing natural additions rather than synthetic ones [19]. Due to their alleged safety and possible nutritional and therapeutic benefits, natural antioxidants found in foods and other biological materials have garnered a great deal of attention. Numerous research using commercially available naturally occurring antioxidants of plant origin have been conducted. Commercially available versions of some of these organic antioxidants are also available [21]. The determination of the antioxidant content of many plant species, including vegetables, fruits, spices, herbs, and grains, is driven by the increased interest in natural antioxidants [17]. As a result, using plant-derived antioxidants as natural antioxidants is becoming more and more common. Numerous studies have examined the effects of natural antioxidants and packaging changes on the stability of lamb meat products during frozen storage. For instance, the oxidative stability of lamb meat products while they were frozen was studied in the [25] study using three distinct natural antioxidants (rosemary extract, grape seed extract, and tea polyphenols). The results showed that all three antioxidants were effective in reducing lipid oxidation and maintaining the sensory quality of the beef products throughout storage. In a separate study, [8] evaluated the effect of MAP on the integrity of lamb flesh while it was frozen. The results showed that MAP significantly reduced lipid oxidation in comparison to control samples and improved the sensory quality of the meat. The oxidation process that results in rancidity in fats is greatly slowed down by vacuum packaging and antioxidants, limiting fat degeneration. Contrarily, hoover packing lowers the oxygen level and prevents air from entering the product, successfully preserving lipids. By limiting the availability of oxygen, which is a crucial factor in promoting lipid oxidation, vacuum packaging reduces the rate of oxidation [10]. The current study was set out to investigate the combined effects of a natural antioxidant (grape seeds extract), and packaging treatment (without and with vacuum), on the chemical composition, some physical and microbiological characteristics, and sensory evaluation of the lamb meat burger stored frozen for 8 months.

MATERIALS AND METHODS

Lamb meat: Fifteen kg of lamb meat (flank) were purchased from the local market of Minia city, Egypt, and transported under refrigeration to the laboratory within 30 min. The meat were washed, deboned, then were minced by meat mincer (Nr-963009, Scharfen, Witten,

Germany) through an 8mm grinder plate. Samples were directly analyzed at zero time, while others were prepared for formulation into burger.

Grape Seeds: Grape (Vitis vinifera L.) (Roumy ahmer) was purchased from local market at Minia city, Egypt. The seeds were taken out, cleaned, and dried at room temperature.

Packaging materials: In this study, two types of packaging materials were used. The one is low-density polyethylene (LDPE) bags was purchased from a local market in Minia City, Egypt. The second one was laminated PE/Nylon bags from Cryovac Co. in the United States.

Ingredients: The spice mixture (onion powder, salt, and black pepper), dry bread crumb, fresh egg, and starch were purchased from the local market at Minia city, Egypt.

Chemicals and reagents: The chemicals were utilized in this study were obtained from Al-Gomhoria Company, Egypt.

Preparation of seeds extract: Grape seeds extract was prepared according to the method described by [15].

Formulation of lamb meat burger: The recipe from [11], which is listed in table (1), was used to make lamb meat burgers.

Table 1 lamb meat burger formula

Ingredients	%
Minced lamb meat	78
Bread crumb	6
Fresh egg	3
Starch	4
Onion powder	1
Salt	1
Black pepper	1
Ice	6

The process for manufacturing a lamb meat burger utilizing lamb flesh (flank), with or without 0.1% grape seeds extract (GSE) as the control, is shown in Figure 1. The ingredients were mixed together for 5 minutes in a Classic Chef KM 353 Kenwood meat mixer (Kenwood Ltd., Havant, UK), and then the mixture was formed into burgers (50 g weight, 10 cm diameter, and 0.5 cm thickness) using hand presses (Italman, Italy). The product was then placed in one of two types of bags: laminated poly ester/Nylon bags with a vacuum, and low density poly ethylene bags without a vacuum. The entire batch of samples was kept frozen at -18 C for eight months.

Analytical techniques:

Lamb meat burger's chemical composition: Official Methods [2] were used to calculate the approximate chemical composition of moisture, crude protein, ether extract, pH, total acidity, and ash.

Determination of moisture loss: The moisture content loss for the lamb meat burger (packaged without or with vacuum) was measured along with the frozen storage period in accordance with the [3] technique.

Determine the total acidity: Titration was used to determine the total acidity of frozen lamb meat burgers that were packaged using two different procedures, in accordance with the method outlined by [9].

Determine the pH: The pH of the lamb meat burger slurry was tested using the glass-electrode method, according to [20].

Thiobarbituric acid (TBA) value: The levels of TBA were separately determined for frozen lamb meat products packaged with and without vacuum. Compounds that react with TBA were measured using the [7] method. The data were translated from mg TBA/1000g lamb meat product to mg malonaldehyde/1000g product and recorded as TBA values.

Determination of (TVN) value of lamb meat product: The total volatile nitrogen (TVN) was estimated according to the method described by [23].

Measurements of expressible water (EW) and water holding capacity (WHC): According to [1], the water holding capacity (WHC) was measured. To calculate expressible water, apply the formula below:

EW = 100 x (PW - AW)/PW

AW stands for "after-pressed weight," and **PW** stands for "pre-pressed weight."

Following are the steps for calculating water holding capacity:

WHC % = % Content of moisture – EW
Total plate count: The procedures described in the accepted practices of [4 & 22] were used to calculate the total plate count for the lamb meat products packaged with and without vacuum as (CFU/g).

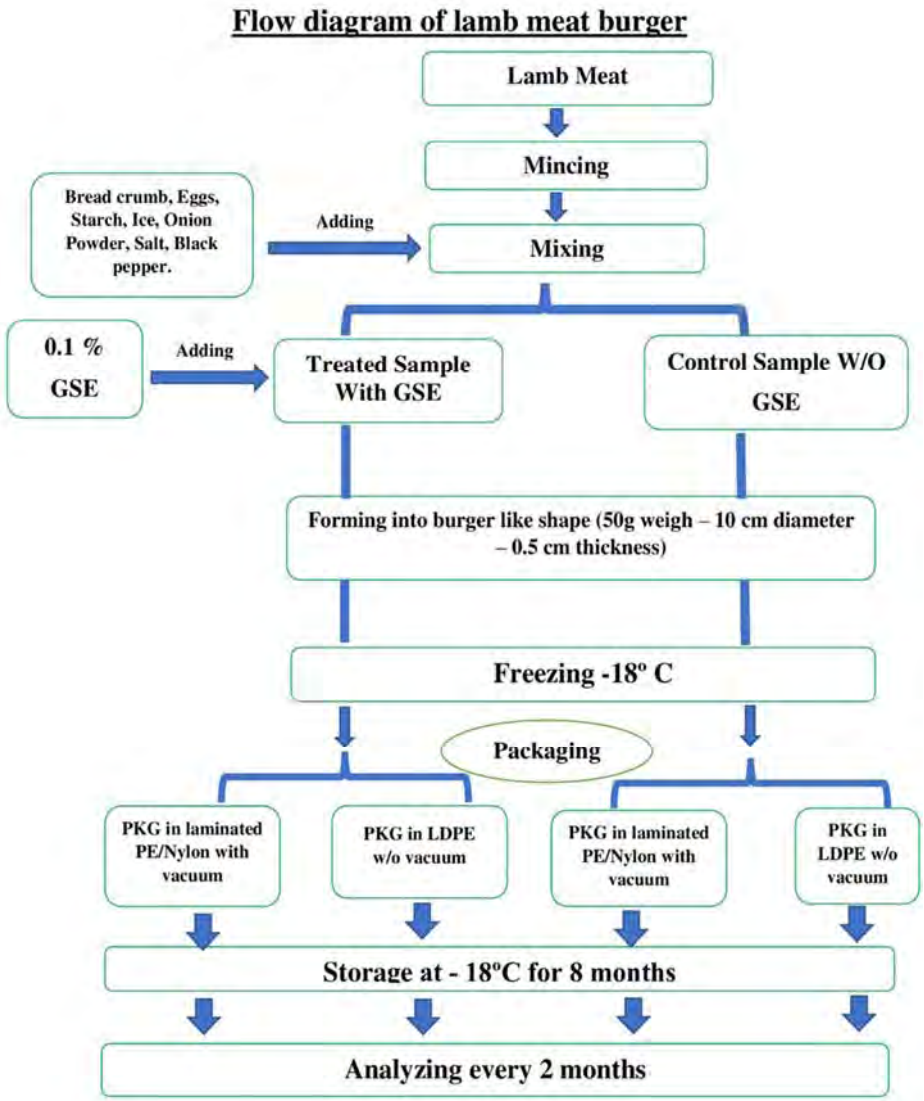

Fig. 1 Flow diagram of lamb meat burger

Sensory evaluation: Using the criteria outlined by [14], the cooked lamb meat patties (control and treated by 0.1% grape seeds extract) that were packaged with or without vacuum and maintained frozen for 8 months received sensory evaluation for general acceptability. This test was administered by ten judges. The evaluation was conducted using a numerical hedonic scale, with 1 denoting severely poor and 10 denoting superb.

RESULTS AND DISCUSSIONS

Meats have been consumed primarily due to their high concentration of essential amino acids and iron, both of which are essential for general health, children's bone development, and lactating mothers, as well as the fact that they are an excellent source of the proteins required for muscle growth and human body development. Iron also protects against anemia in children and nursing mothers [18]. To enhance the population's daily protein consumption, sheep farming is promoted in Egypt. In order to ensure food security, Egypt's plan heavily relies on sheep [6]. Table (2) lists the chemical makeup of treated and untreated lamb meat burgers under various packaging processes (wet weight). Data showed that for all samples at zero time of storage under frozen conditions, there were no appreciable differences in moisture content, protein content, total ash content, or water holding capacity between the various treatments. The findings, however, revealed some variations in the extract, pH, total acidity, TVN, and TBA values between the treatments. The addition of 0.1% grape seed extract, which contains certain phenolic antioxidant bioactive compounds with antioxidant, antibacterial, and anti-immune characteristics, may have had an impact on these modifications.

Figure (2) shows how packaging methods, 8 months of freezer storage, and.01% grape seed extract affect the amount of moisture that lamb meat patties retain. It is evident that the moisture content of all samples reduced as storage times grew longer. In comparison to samples that included 0.1% grape seeds extract, the reduction in moisture content was a little bit more in the control samples. Vacuum packaging also preserved a little bit more moisture in the samples than non-vacuum packaging. This demonstrates that the addition of grape seeds extract may have a much higher capacity to pound water when compared to the control samples. Vacuum packaging is used to prevent shrinkage, maintain color and delay spoilage when fresh meat is sold at wholesale pricing.

Table 2 Chemical composition of treated and untreated lamb meat burger in different packaging treatments (wet weight)

Constituents (%)	Control W/O Vac.	Control with Vac.	Grape seed extract W/O Vac.	Grape seed extract with Vac.
Moisture	60.49	60.57	60.89	60.76
Protein (NX6.25)	15.83	15.91	15.61	15.92
Ether extract	19.21	19.73	18.91	18.63
Total ash	1.77	1.69	1.71	1.75
pH	5.75	5.64	5.66	5.65
Total acidity	0.26	0.30	0.27	0.28
WHC	43.26	43.25	43.49	43.11
TVN	9.36	7.79	7.49	7.36
TBA	0.218	0.168	0.148	0.137

*Mean of 3 replicates
Control W/O Vac. = Control samples packaged without vacuum.
Control with Vac. = Control samples packaged under vacuum.
Grape seed extract W/O Vac. = Grape seeds extract treated samples packaged without vacuum.
Grape seed extract with Vac. = Grape seeds extract treated samples packaged under vacuum.

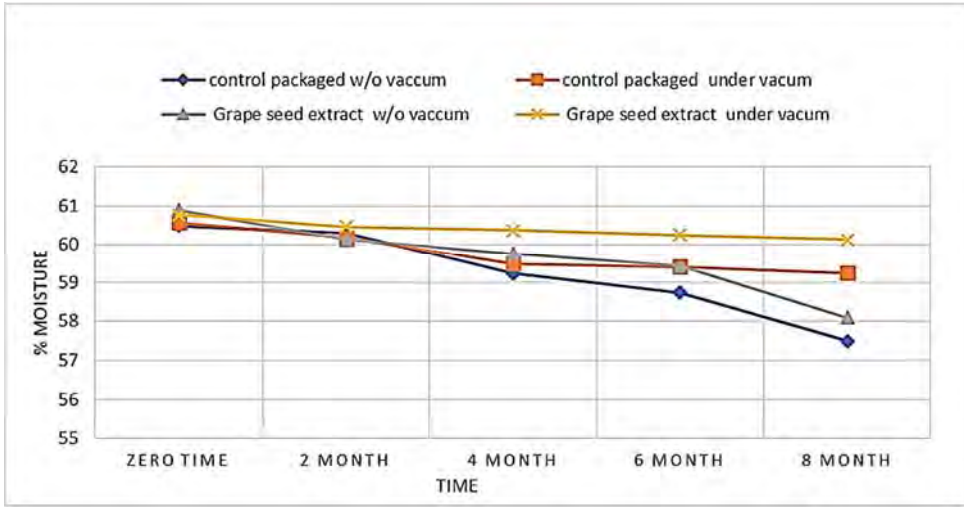

Fig. 2 Effect of packaging treatment, grape seeds extract, and time of frozen storage on moisture retention % of lamb meat burger

Due to the packaging materials utilized and the vacuum technique, which eliminates the head space between the food ingredients and the packaging side, the packaging under vacuum treatment also reduced moisture content loss.

The total acidity of the control and 0.1% grape seeds extract treated lamb meat burgers was shown in fig. (3) as a function of storage time (8 months) under freezing conditions, packaging treatments (without vacuum in LDPE, and with vacuum in laminated PE/Nylon bags), and treatment by grape seed extracts as a natural antioxidant. The data showed that the overall acidity levels rose during the course of all sample storage durations. The control samples exhibited the highest overall acidity in contrast to samples treated with 0.1% grape seeds extract. The length of storage period and the rise in the total acidity levels were both reduced by vacuum packaging. This result was in line with the pH ranges for the investigated medicines.

Figure (4) shows the variations in pH values for lamb meat product samples that were frozen with or without vacuum storage for 8 months (control and lamb meat burger treated with 0.1% grape seeds extract). Data showed that all treatments' pH values considerably decreased during the storage period. The decline was greater in samples not vacuum-packed compared to samples that were. This demonstrates how the packaging process significantly affects the pH level of the stored goods.

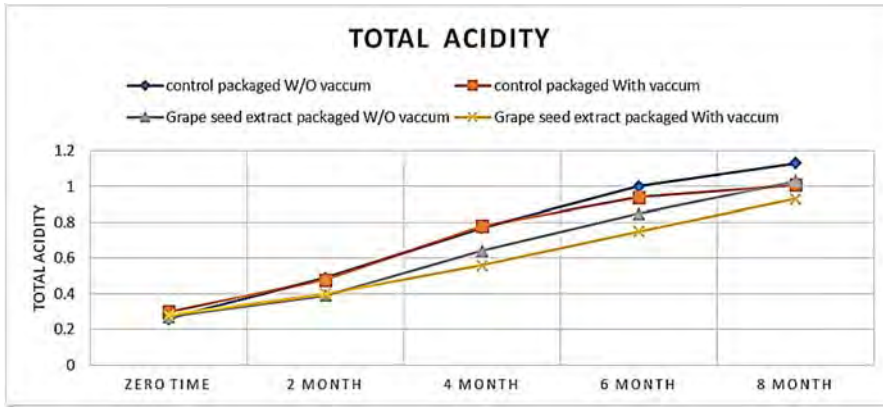

Fig. 3 Effect of packaging treatment, grape seeds extract, and time of frozen storage on the total acidity values of lamb meat burger

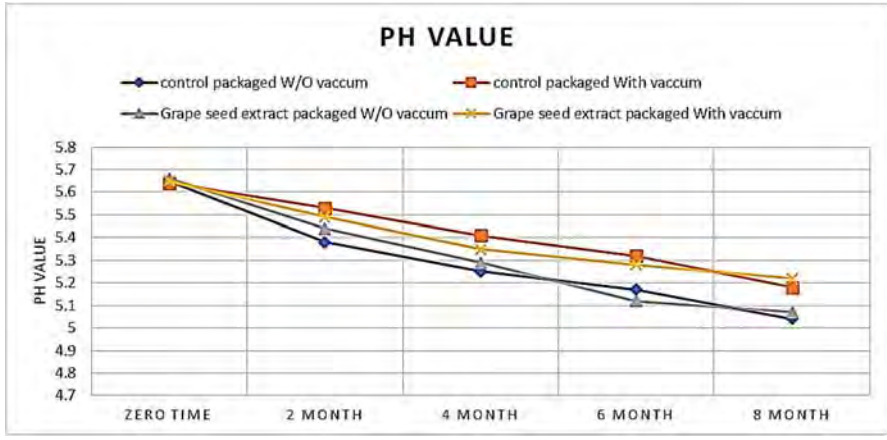

Fig. 4 Effect of packaging treatment, grape seeds extract, and time of frozen storage on the pH values of lamb meat burger

Due to its intricate chemical and physical composition, meat is an extremely perishable food that easily oxidizes. Because it depletes them of vitamins, necessary amino acids, and essential fatty acids, oxidation of lipids, proteins, or pigments is one of the most common reasons why the nutritional value, flavor, and texture of meat and meat products diminish. Figure (5) illustrates the effects of storage (8 months under cold circumstances), packaging (without vacuum in LDPE, and with vacuum in laminated PE/Nylon bags), and natural antioxidant treatment on the TBA value. According to the findings, TBA values increased over time for all treatments. The fact that the TBA values for the control samples were greater than those for the ones treated with grape seeds extract demonstrates how effective natural antioxidants are at preventing the formation of oxidative chemicals.

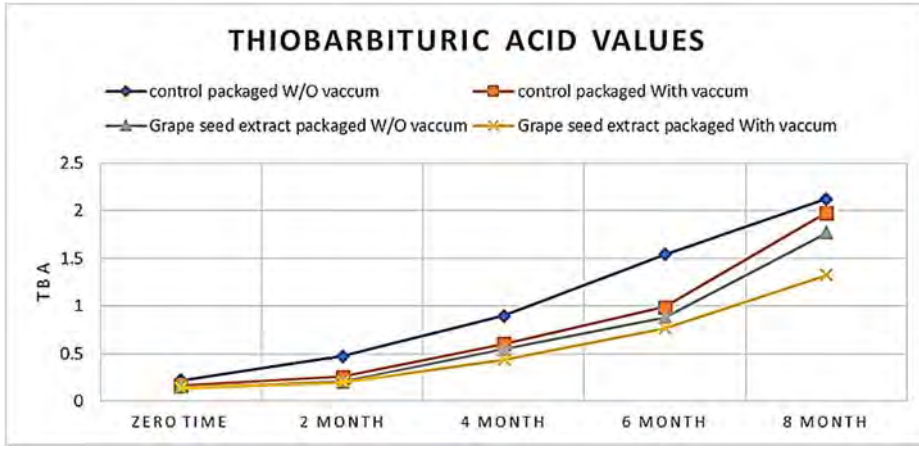

Fig. 5 Effect of packaging treatment, grape seeds extract, and time of frozen storage on the TBA (mg malonaldehyde/kg sample) values of lamb meat burger

Additionally, samples vacuum-packed had lower TBA levels than samples packaged without vacuum, it was found throughout the test. This might be because LDPE materials are more oxygen permeable than laminated PE/Nylon composites, which sped up the oxidation of lipids.

TVN is a reliable food quality indicator, especially for meat and meat products. Because of the potential for protein degradation brought on by microbial development and its proteolysis enzymes (ammonia), TVN in meat products may normally rise over the course of storage. The total volatile nitrogen (TVN) on the lamb meat burger was treated with grape seed extract as a natural antioxidant, and the results were shown in fig. (6). The storage period (8 months) under freezing circumstances, packing treatments (without vacuum in LDPE, and with vacuum in laminated PE/Nylon bags), and treatment were all exhibited. The results showed that (TVN) levels increased with storage time in every sample. In comparison to the control, the values of the (TVN) were somewhat lowered by the addition of grape seed extract. Vacuum packaging proved very helpful in preventing the growth of total volatile basic nitrogen (TVN) during frozen storage.

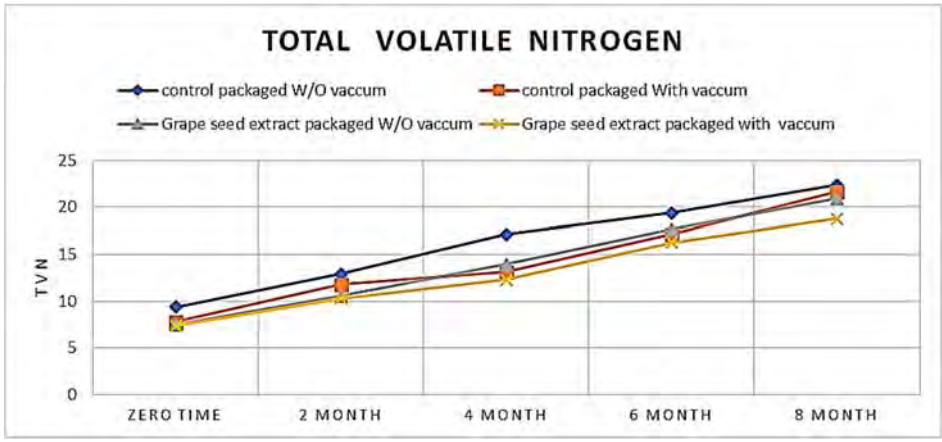

Fig. 6 Effect of packaging treatment, grape seeds extract, and time of frozen storage on the TVN values of lamb meat burger

On the water holding capacity (WHC) values of lamb meat patties frozen for 8 months is shown in fig. (7), along with the effects of packing methods and the inclusion of grape seeds extract (0.1%) as a natural antioxidant. The findings demonstrated that as storage time rose, the levels of (WHC) reduced for all samples. For samples packaged without and with vacuum, respectively, the rate of reduction in the control samples was much higher than it was in the samples treated with grape seeds extract after 8 months of frozen storage.

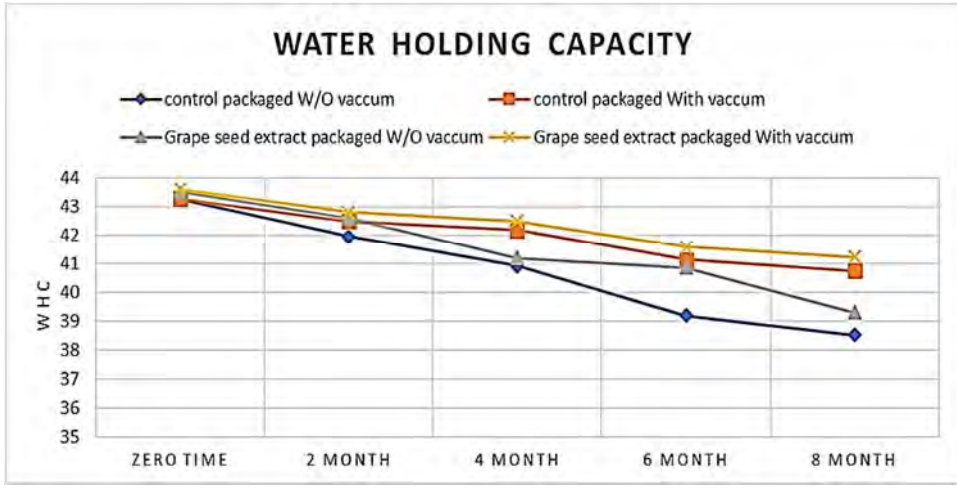

Fig. 7 Effect of packaging treatment, grape seeds extract, and time of frozen storage on the water holding capacity (WHC) of lamb meat burger.

Expressible water (EW) is the volume of water that was extracted from the protein matrix during a research. When a given amount of pressure is applied to the protein matrix, the amount of water evacuated is determined. Figure (8) depicts the effects of packing treatment and the use of grape seeds extract as a natural antioxidant for eight-month-stored lamb meat product. The statistics show that the expressible water contents of all samples rose after storage. The increment was noticeably higher for the control samples when compared to samples treated with 1% grape seed extract for samples packaged without and with vacuum, respectively. All of this points to the fact that the quality of frozen lamb meat burgers was improved by the use of vacuum packaging.

Fig. 8 Effect of packaging treatment, grape seeds extract, and time of frozen storage on the expressible water (EW) of lamb meat burger

The amount of aerobic bacteria found in meat and its products is frequently used as a sign of unsanitary handling and storage procedures that may encourage the spread of diseases. In the lamb meat product treated with grape seeds extract and the control (packaged in LDPE without vacuum and in laminated PE/Nylon bags under vacuum), Figure (9) shows the association between packing treatment and frozen storage period on the total bacterial count (log CFU/g). Following each treatment and throughout storage, there was a decrease in the overall bacterial count. Aerobic bacteria cannot thrive in vacuum settings, as seen by the significantly reduced total bacterial population in the vacuum-packed samples. Furthermore, it was shown that samples containing 0.1% grape seed extract had lower bacterial counts than control samples (which did not contain 0.1% grape seed extract).

The qualities that appeal to consumers, such as those that are both aesthetically beautiful and sensuous, as well as those that are healthful, secure, and other more ethereal features, are what determine the quality of meat. Meat and meat products' overall eating quality is influenced by traits like flavor, texture, juiciness, appearance, and odor. The effects of packing (in LDPE without vacuum and in laminated PE/Nylon bags under vacuum), adding 0.1% grape seed extract as a natural antioxidant, and preserving lamb meat patties frozen for 8 months are shown in Figure (10). The data showed that the values for overall acceptability declined as storage times for all samples increased. The evaluation results for overall acceptability were greater in samples treated with 0.1% grape seeds extract than in untreated samples. This means that during frozen storage, treatment with 0.1% grape seed extract will safeguard and improve the quality of the lamb meat product. According to the panelists' assessments, lamb meat burgers packaged under vacuum had a positive impact on the product's quality throughout storage for 8 months under storage conditions as opposed to those packaged without vacuum.

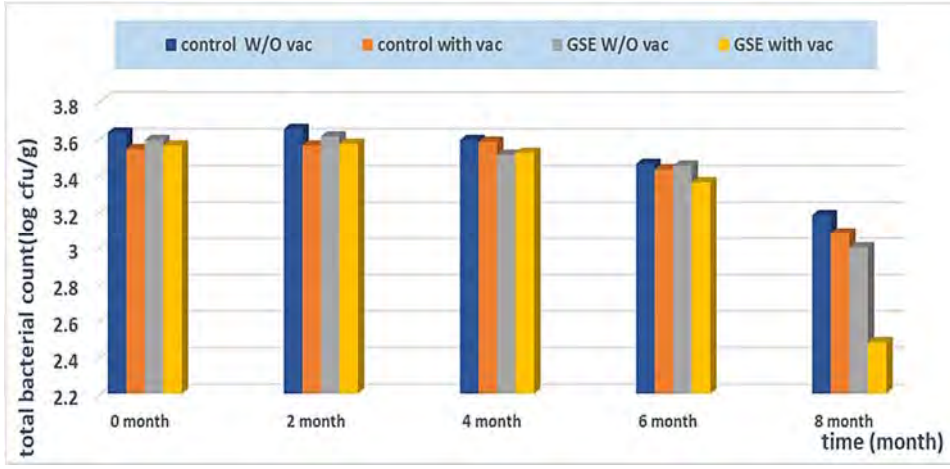

Fig. 9 Effect of packaging treatment, grape seeds extract, and time of frozen storage on the total bacterial count ((Log CFU/g) of lamb meat burger

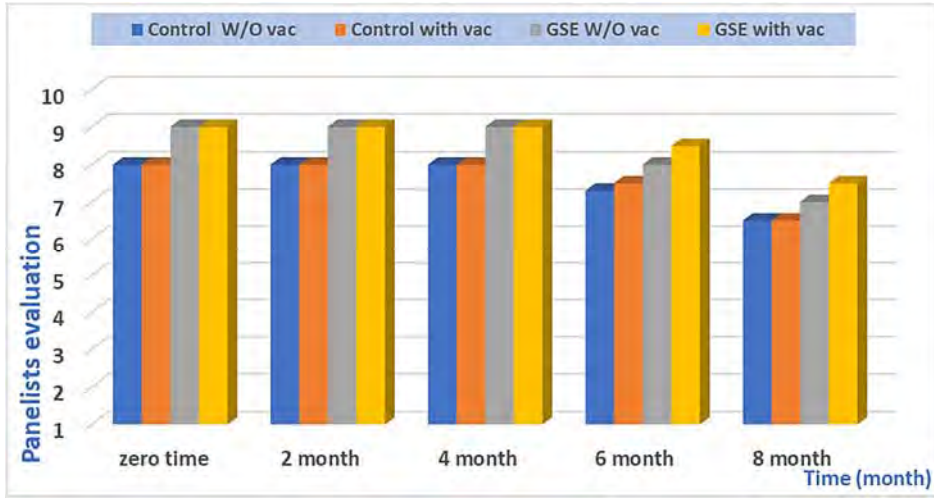

Fig. 10 Effect of packaging treatment, grape seeds extract, and time of frozen storage on the sensory evaluation (overall acceptability) of lamb meat burger

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