EFFECT OF STORAGE TIME, NATURAL ANTIOXIDENT, AND PACKAGING TREATMENTS ON THE QUALITY OF CHICKEN MEAT PRODUCT

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Abstract

Proximate composition, moisture loss, total acidity, pH value, TBA value, WHC, Expressible water, total bacterial count, and sensory evaluation were done in order to study the effect of natural antioxidant (thyme powder), and packaging treatment on the stability of chicken meat burger made from chicken thighs and stored frozen for 8 months. The data indicated reduction in the moisture content, and pH value, while increase in the total acidity, and TBA values for the control samples compared to the treated ones. The data showed that the treated samples by 1% thyme powder had the lowest values of TBA, total bacterial count compared with the control ones. In addition, it has higher evaluation values for overall acceptability than the control one.

Key words: *Thyme, antioxidant, packaging treatment, chicken product*

INTRODUCTION

Meat is one of the priciest and most prone to damage items. Due to its chemical composition, which renders it sensitive to microbial contamination and lipid oxidation that lead to degradation and loss of market acceptance [7]. A number of variables, such as color, lipid stability, and microbiological purity, have an impact on the shelf life of meat. Foods that are particularly nourishing and beneficial, like bird meat, have recently attracted a lot of attention [15]. Worldwide, there is a rapid increase in the consumption of poultry meat and its byproducts [20]. To satisfy the rising consumer demand for processed and ready-to-eat chicken meat products, the ability to produce and incorporate new value into poultry products was required [19]. Food safety is a serious concern because of the onset and spread of the pathogen-caused food-borne illness. The new situation raises the need to use chemical preservatives, antioxidants, and antibacterial agents in order to avoid or at least delay the deterioration caused by bacteria and/or lipid oxidation [6]. The safety of food additives is another issue that worries people [9]. Due to this problem, scientists started to think about using natural chemicals instead of synthetic ones. The freezing process can have a significant impact on the ability of fish and meat muscles to store water [11]. Other processing methods like frying, drip loss, and evaporation may also cause some water content loss. The water content and distribution within the meat matrix are known to have a major impact on the features, hardness, appearance, and juiciness of meat and fish muscles. Testing the muscles' ability to hold water is one of the many important processes needed to characterize the quality of flesh and understand its qualities. Microbiological infection and lipid oxidation are the main factors impacting food quality and food safety. Therefore, preventing or at least postponing lipid oxidation and reducing bacterial cross-contamination are of utmost importance to food processors [13]. During production, processing, distribution, and storage, food degrades as a result of chemical

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reactions and microbial activities [14]. Oxidation is the main cause of such degradation due to its negative effects on the sensory qualities (odor, flavor, texture, color, etc.). Additionally, lipid oxidation may produce harmful chemicals and have a negative effect on nutritional value [18]. Due to its complicated physical structure and chemical make-up, which both render it sensitive to oxidation, chicken meat is easily exposed to lipid oxidation [26 & 22]. Adding antioxidants to meals that include fat is an effective strategy to postpone rancidity, limit the production of toxic compounds, retain nutritional value, and extend the shelf life of fatty food products. However, the use of these substances has been associated with health hazards, which has resulted in strict regulations over their use in food, which has stimulated research for substitute antioxidants [16]. Recently, there has been a lot of interest in using natural additives in place of synthetic ones to balance out meals heavy in fat [23]. Natural antioxidants present in foods and other biological materials have drawn a lot of interest due to their purported safety and potential nutritional and therapeutic benefits. Particularly phenolics and flavonoids are safe and bioactive natural antioxidants. How many distinct plant sources of meat there are that have natural antioxidants has been studied. It is becoming more common to separate antioxidants from plants and use them as natural antioxidants as a result [22]. Oregano and thyme are two herbs and spices that are well known for being potent antioxidants. Thymol and carvacrol, two phenolic chemicals found in essential oil fractions, have been linked to their antioxidant activity. Freezing is a method for minimizing any physical, chemical, and microbiological changes that take place during storage and affect the quality of food goods. After the meat was frozen, almost 80% of its water content changed into ice crystals coupled with a separation of dissolved materials, which slows down the activity of enzymes and bacteria in food [9]. It is well known that protecting food from biological, physical, and environmental harm that could compromise food quality and safety and result in contamination is the main goal of packaging treatment. In especially for clean and meat goods during storage, vacuum packaging is widely employed to ensure food safety from a microbiological perspective, improve its quality, and extend its shelf life. Because chicken flesh and its products are so susceptible to microbial deterioration, packaging is very necessary [13].

Examining the combined effects of a natural antioxidant and packaging treatment on the chemical composition, some physical and microbiological characteristics, and sensory evaluation of the chicken product during frozen storage for 8 months was the goal of the current study.

MATERIALS AND METHODS

Thyme (Thymus vulgaris) powder: The thyme plant was obtained from Assiut University Faculty of Agriculture. The leaves were removed, cleaned, and air dried for two days before being ground in a Moulinex mill (TYPE 2282-00, France) to a 60 mesh powder.

Chicken meat: Fifteen kg of chicken thighs were obtained from the local market in Minia, Egypt. The thighs were cleaned, deboned, and the meat was minced in a meat mincer (SAP Meat Mincer TC 22, Italy) using an 8mm grinder plate. The meat was then refrigerated until it was made into a burger.

Spice mixture: Salt, crumbled rusk, a whole egg, and fresh onion were all bought at the local market in Minia, Egypt. Defatted soybeans were bought from the Family Trade Company for Industry and Trade in Shubramit on Abu Nomers Road.

Packaging materials: Two distinct types of packaging materials were used in this experiment. Low density polyethylene (LDPE) bags in the first batch were purchased from a store in Minia, Egypt. The second was laminated PE/Nylon bags from Cryovac Co., USA.

Preparation of chicken meat product: The recipe from [3], which is shown in table

(1), was used to make chicken thigh meat burgers.

Figure (1) depicts the flowchart for the production of a chicken meat burger made from chicken thighs either without (control) or with 1% thyme leaf powder.

Table 1 chicken burger formula

Ingredients	Treatment	
	Control (without thyme)	With 1% thyme powder
Minced chicken thighs meat	71.5%	70.5%
Fresh onion	7%	7%
thyme powder	-----	1%
crushed rusk	5 %	5 %
whole egg	5 %	5 %
Soybeans powder	10%	10%
Salt	1.5%	1.5%

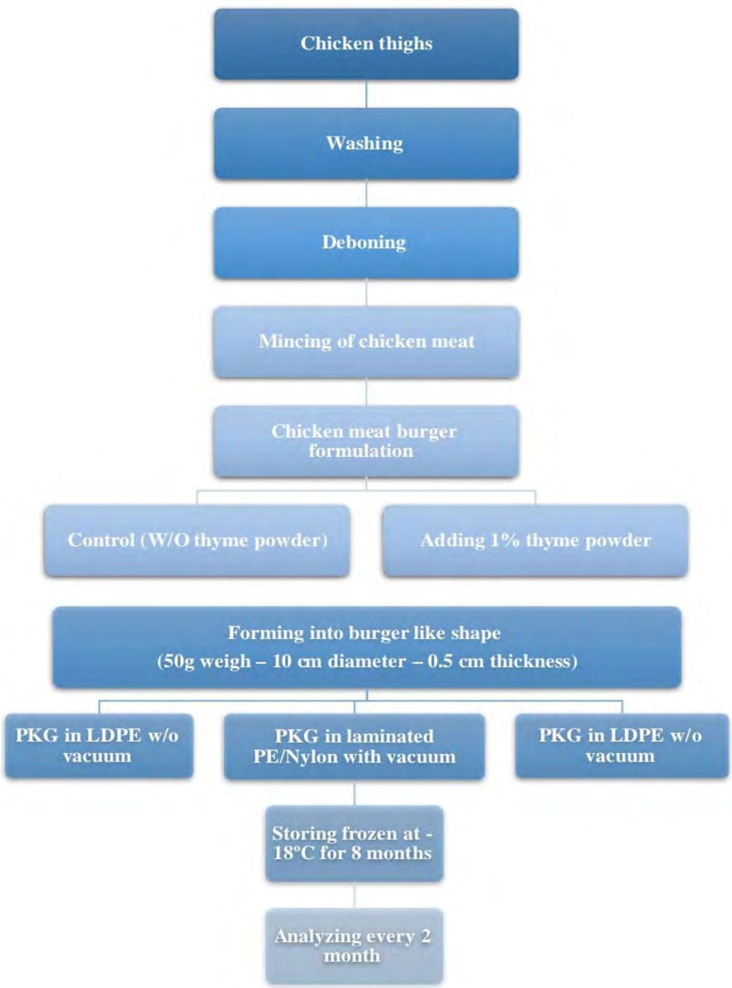

Fig. 1 Flow diagram of chicken thigh burger

Analytical procedures: Moisture, crude protein, and either extract for chicken thigh meat burgers were measured at zero time using the procedures described in [4].

Determination of moisture loss: Moisture content loss for the chicken thighs burger (packaged without or with vacuum) was measured along with the frozen storage period in accordance with the [4] procedure.

Total acidity determination: In accordance with the strategy provided by [4], titration was used to assess the total acidity of frozen chicken items that were packaged using two distinct processes.

pH measurement: A slurry was made by mixing 5 g of the chicken product with 45 ml of distilled water. According to [21], the pH of the slurry was measured using the glass-electrode method.

Thiobarbituric acid (TBA) value: For frozen chicken thighs packaged with and without vacuum, the levels of thiobarbituric acid (TBA) were calculated independently. The [10] approach was used to measure TBA-reactive compounds. A Spectronic 710 Spectrophotometer was used to measure the colorimetric absorbance at 530 nm. Readings were recorded as TBA values (mg TBA/1000g chicken meat product) and converted to mg malonaldehyde/1000g product.

Expressible water (EW) and water holding capacity (W.H.C.) measurements: A measurement of water holding capacity (W.H.C.) was made, according to [2]. For expressible water, the following computation is used:

EW= (PW - AW)/PW X 100

Where:
PW = "pre-pressed weight," and
AW = "after-pressed weight."
Calculating water holding capacity is done as follows:
WHC % = % Moisture content – EW

Total plate count: The total plate count for the chicken meat products packaged with and without vacuum were made as (CFU/g) using the methods indicated in the approved practices of [5 & 25].

Sensory assessment: The cooked chicken burgers that were packaged with and without vacuum and kept frozen for 8 months underwent sensory evaluation for overall acceptability in accordance with the guidelines provided by [17]. Ten judges participated in this test. A numerical hedonic scale was used for the evaluation, with 1 standing for extremely poor and 10 for outstanding.

Statistical analysis: Data were analyzed using analysis of variance (ANOVA) in the SPSS statistical package program, and Duncan's Multiple Range test was used to see whether there were any differences in means [24].

RESULTS AND DISCUSSIONS

Chicken flesh is one of the materials that decomposes most quickly. Due to its physical and chemical characteristics, which rendered it vulnerable to microbial spoilage and growth, which led to the degradation of chicken flesh and its products [7]. Consumers prefer chicken over other meats or meat substitutes because they are concerned about their health and prefer non-red meat products [1]. They prefer to eat chicken since it is more practical, less expensive, and tastes better.

Table (2) shows the chemical composition of chicken thigh burgers as a percentage of fresh weight at zero time of storage, including moisture content, crude protein, either extracts, total acidity, pH, and TBA as mg malonaldehyde/kg. The data revealed no differences in the overall acidity and moisture content between the thyme-added control sample and the thyme-added sample for the crude protein, either extract, TBA, and pH values. The data indicated that the final product's chemical composition was not significantly changed by the addition of 1% thyme powder to the formula for chicken thigh meat burgers.

Table 2 Chemical composition of chicken thigh meat burger without and with 1 % thyme powder (fresh weight)

Constituents	Treatments	
	Control	With 1% thyme powder
Moisture %	64.8	64.1
Crude protein* %	21.8	21.7
Ether extract %	5.6	5.5
TBA (mg malonaldhyde/Kg sample)	0.53	0.53
Total acidity	0.80	0.84
pH	5.95	5.96

**N x 6.25* *Average of 3 means ± SD*

The chemical composition of chicken thigh burgers is shown in Table 2 as a percentage of fresh weight at the beginning of storage (moisture content, crude protein, ether extracts, total acidity, pH, and TBA as mg malonaldehyde/kg). The results revealed no appreciable differences between the control sample and the thyme addition in the crude protein, ether extract, TBA values, and pH values, but only minor variations in the moisture content and total acidity values. The information demonstrated that the chemical composition of the finished product was not significantly changed by the addition of 1% thyme powder to the formula for chicken thigh meat burgers. Figure (2) illustrates the impact of packaging techniques, an 8-month term of storage under freezing conditions, and thyme powder on the moisture retention of chicken burgers made from chicken thighs. It is clear to see that as storage times lengthened, moisture content for all samples decreased. The reduction in moisture content was slightly greater in the control samples compared to those that contained 1% thyme powder. Additionally, compared to samples packaged without vacuum, vacuum packing kept a little bit more moisture in the samples. This shows that compared to the control samples, the thyme powder may have a significantly higher ability to pound water. Figure (3) shows how the pH values for the samples (control and chicken thighs with thyme powder) changed. Data revealed that over the storage period, the pH values for all treatments fell significantly. In the treated samples compared to the control samples that weren't treated, the decline was higher. This indicates how thyme's antioxidant qualities, which are responsible for the pH reduction, work. The data also showed that the pH values changed as a result of applying vacuum packaging. As a function of storage time (8 months) under freezing conditions, packing treatments (without vacuum in LDPE, and with vacuum in laminated PE/Nylon bags), and storage period (8 months), the total acidity of control and 1% thyme powder treated chicken patties was illustrated in fig. (4). The data demonstrated an increase in the overall acidity levels as storage times for all samples progressed. In comparison to samples treated with 1% thyme powder, the control samples had the highest overall acidity. Vacuum packaging decreased both the storage time and the increase in the overall acidity levels.

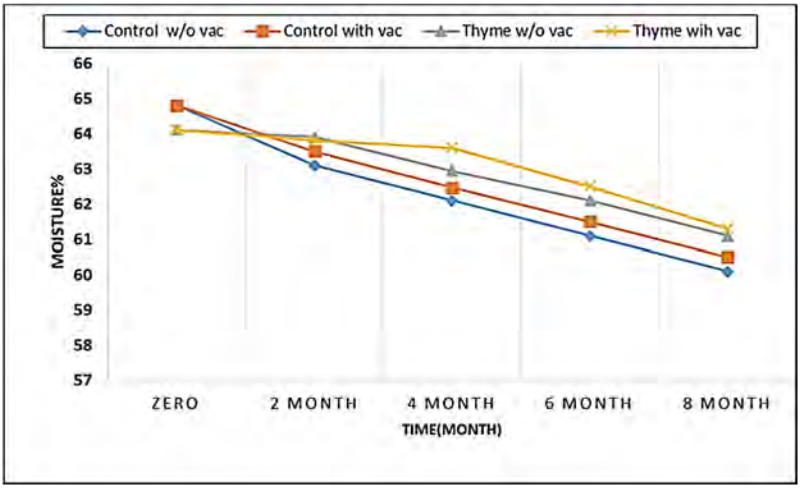

Fig. 2 Effect of packaging treatment, thyme powder, and time of frozen storage on moisture content% of chicken thighs meat burger

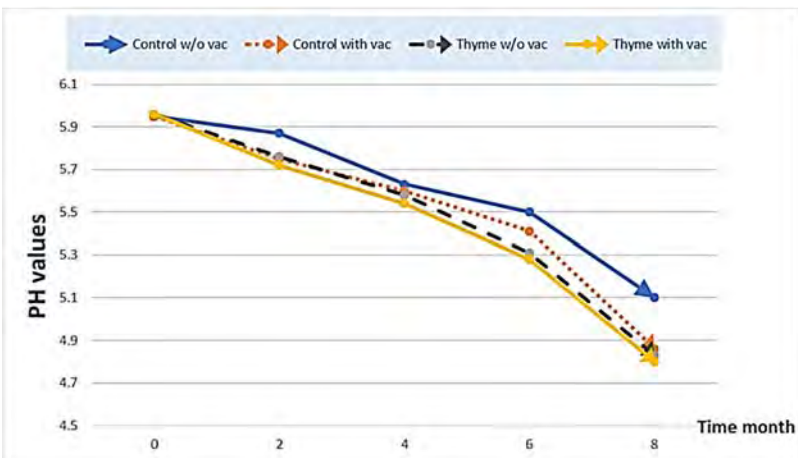

Fig. 3 Effect of packaging treatment, thyme powder, and time of frozen storage on the pH values of chicken thighs meat burger

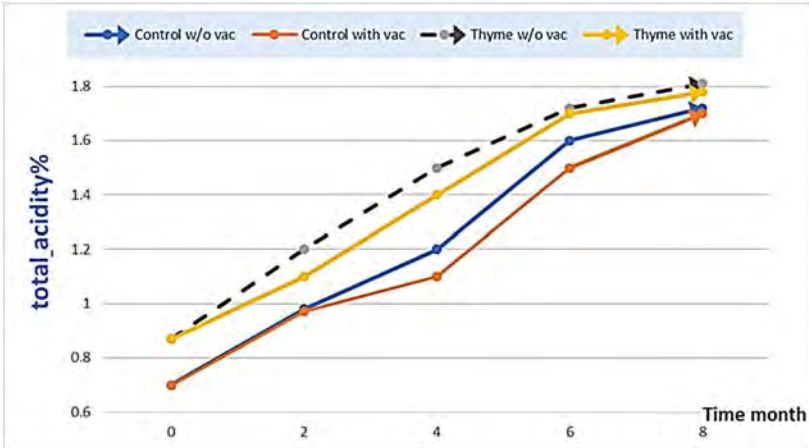

Fig. 4 Effect of packaging treatment, thyme powder, and time of frozen storage on the total acidity values (lactic acid) of chicken thighs meat burger

The effects of storage time (8 months under frozen conditions) and packaging treatments (without vacuum in LDPE, and with vacuum in laminated PE/Nylon bags) on the TBA (mg malonaldehyde/kg sample) values of control and chicken thigh meat burgers extended by 1% thyme powder as natural oxidant are shown in fig. (5). The data showed that the TBA values for all treatments rose with storage time. The difference between the TBA readings for the control and thyme powder-treated samples shows that the herb has the ability to stop the formation of oxidative compounds.

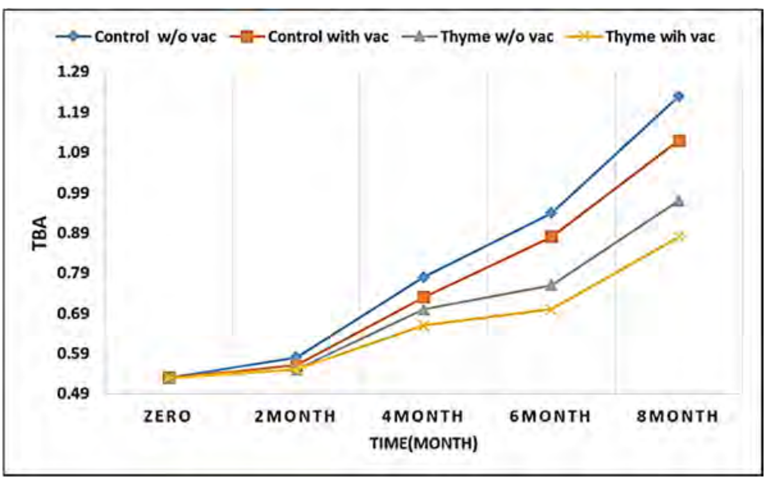

Fig. 5 Effect of packaging treatment, thyme powder, and time of frozen storage on the TBA (mg malonaldehyde/kg sample) values of chicken thighs meat burger

Additionally, it was discovered during the research that samples vacuum-packed had lower TBA levels than samples not. This might be due to the fact that LDPE materials have a higher oxygen permeability than laminated PE/Nylon composites, which accelerated lipid oxidation.

The vacuum packaging treatment had an adverse effect on the TBA values (they were lower than with non-vacuum packaging).

Thyme has incredible and considerable antioxidant activity and can be used as a source of free radical scavengers. Its phenolic and flavonoid concentration is to blame for this.

In fig. (6), the impact of packing treatments and the addition of thyme powder (1%) as a natural antioxidant on the water holding capacity (WHC) values of chicken thigh meat burgers frozen for 8 months is depicted.

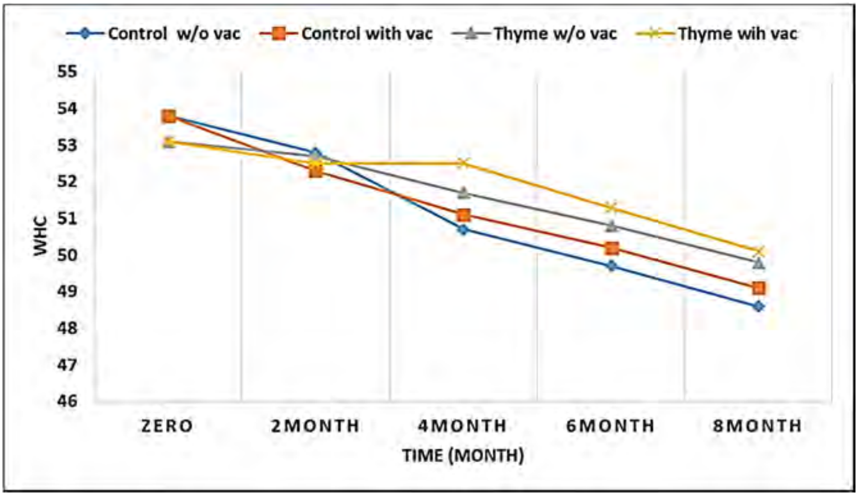

Fig. 6 Effect of packaging treatment, thyme powder, and time of frozen storage on the water holding capacity (WHC) of chicken thighs meat burger

The results showed that the amounts of (WHC) decreased for all samples as storage time increased. When compared to samples that were treated with thyme powder, the rate of reduction was substantially higher in the control samples.

The effect of packing treatment and the addition of thyme powder as a natural antioxidant on the % expressible water values of chicken thigh meat burgers frozen for 8 months is shown in Figure (7). All samples' expressible water volumes increased over the course of storage, according to the data. Comparing the control samples to the samples treated with 1% thyme powder, the increment was much higher in the former. All of this suggests that the use of vacuum packaging had a good impact on the quality of chicken thigh meat burgers that were frozen.

Figure (8) illustrates the impact of packing treatment and frozen storage conditions on the total bacterial count (log CFU/g) of control and thyme-treated chicken patties (packed in LDPE without vacuum and in laminated PE/Nylon bags under vacuum). There was a reduction in the overall bacterial count after each treatment and during storage. The overall bacterial count was much lower in the samples that had been vacuum-packed, proving that aerobic microbes cannot survive in vacuum environments. The samples with 1% thyme powder also showed lower bacterial counts than the control samples (which did not contain thyme powder), it was demonstrated. Fig. (9) shows the impact of packaging (in LDPE without vacuum and in laminated PE/Nylon bags under vacuum) and 8 months of frozen storage on the sensory evaluation (overall acceptability) of control and thyme powder-treated chicken thigh meat burgers. The data indicated that as the storage times for all samples increased, the values for overall acceptability decreased.

The panelists gave the addition of 1% thyme powder a higher rating for overall acceptability. This indicates that the quality of the chicken thigh meat burger was raised and improved by the addition of thyme powder to the recipe.

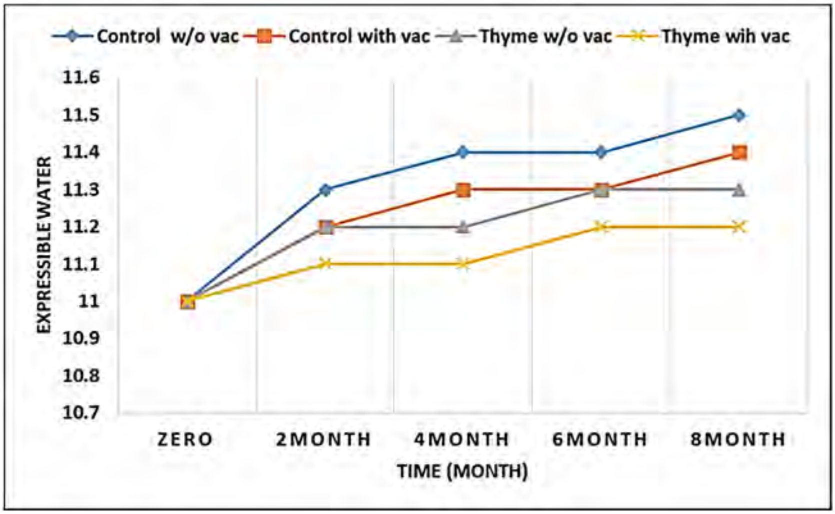

Fig. 7 Effect of packaging treatment, thyme powder, and time of frozen storage on the expressible water (EW) of chicken thighs meat burger

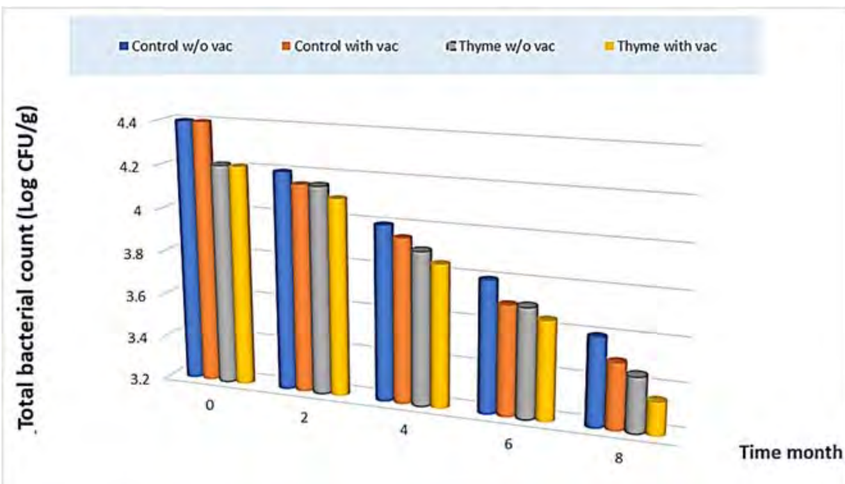

Fig. 8 Effect of packaging treatment, thyme powder, and time of frozen storage on the total bacterial count (Log CFU/g) of chicken thighs meat burger

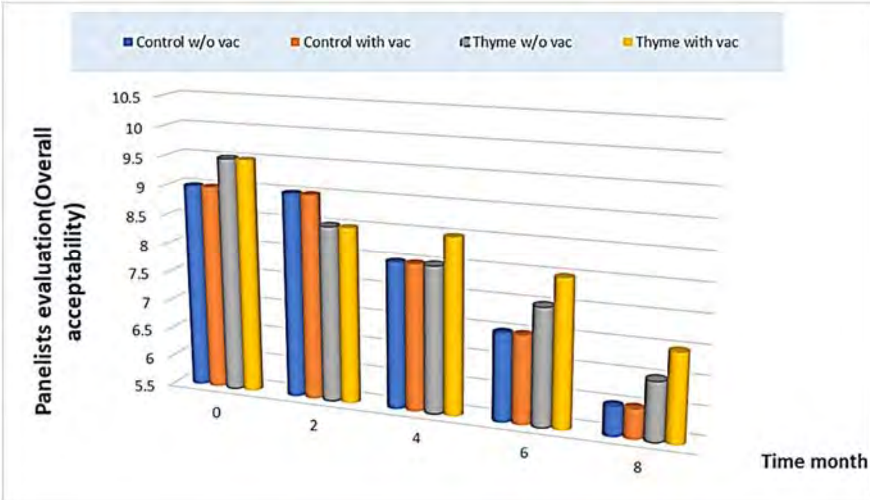

Fig. 9 Effect of packaging treatment, thyme powder, and time of frozen storage on the sensory evaluation (overall acceptability) of chicken thighs meat burger

CONCLUSION

In conclusion, it could be said that the addition of 1% thyme powder, vacuum-sealed packaging, and improved chicken product created from chicken thigh meat, stored for 8 months in a frozen state, improved the product.

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