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QUALITY-PROPERTIES EVALUATION OF BURGERS PROCESSED FROM SPENT-LAYING HENS MEAT

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ABSTRACT

Spent laying hens have a low economic value, especially, after the end of its ability for laying eggs. Since, their meats are tough, firm and less flavor; so it is difficult to consume their meats in the natural form. The present investigation is designated to achieve the maximum benefits of huge amounts of these hens for burger industry.

The evaluation of the nutritional quality of prepared burgers from spent-laying hens during freezing-storage period at -18°C for 4 months was studied. Sodium pyrophosphate and various natural-binding materials such as skin emulsion, pectin and guar gum were used. Results indicated that chemical composition of spent-laying hens was different from muscle to another.

Chemical composition of burger samples was in the permissible levels according to the Egyptian standards. During Frozen storage period, moisture and protein contents were slightly decreased. In contrast, fat, ash and carbohydrate contents showed apparent increase. Sodium pyrophosphate treatment reduced the loss of protein solubility, drip and cooking loss. Besides, it improved WHC and plasticity. Total volatile-nitrogen basis and TBA values were increased with the increment of storage time, but pyrophosphate led to the decrease of both.

Microbiological populations were decreased by storage. Samples treated with pyrophosphate were less microbial counts than control and they were at the permissible levels. Overall-acceptability scores indicated that all burgers were accepted organoleptically.

Finally, it could be concluded that no evidence of spoilage or deteriorative changes was detected in all burger samples even after 4 months of frozen storage at -18°C, and it was also found that formula (5) was the best one.

INTRODUCTION

Spent-laying hens are considered the cheapest source, of protein in comparison with all kinds of meats hence consumers can prefer them to the other economical beef products. However they are tough, firm and less in flavor (Salama *et al.*, 1994 and Ahmed, 1999). Recently, the demand for low fat-meat products has been increased in order to avoid health risks associated with excessive fat intake (Bruhn *et al.*, 1992 and Kircner *et al.*, 2000).

The nutritional value of spent-hens meat and their products were evaluated by many authors (Rao *et al.*, 1995; Vandepopuliere, 1997 and Saleh *et al.*, 2002). They found that they had high nutritional value like other meats. Chemical composition of spent-hens are variable according to differences in meat cut e.g. breast contained higher protein and lower fat than thigh (Ahmed, 1999).

Polyphosphates have been used as additives to beef, poultry and their products during processing to increase color stability, emulsify capacity, inhibition of oxidative changes, flavour deterioration and decreasing microbial load (Chambers *et al.,* 1991 and Choi, 1992). As well as it enhances meat hydration and elevates pH value (Varnam and Sutherland, 1995). Moreover, phosphates reduced the loss of soluble protein, drip, improved water holding capacity and plasticity (Mann *et al.,* 1990 and Moawad, 1995). They also added that utilization of phosphate with sodium chloride increased the effect of polyphosphate treatment. Also, Choi, (1992) reported that the precooked-restructured chicken meat treated with mixtures of phosphate (0.25-0.5%) and low salt, have higher salt soluble protein and lower thiobarbituric acid value (TBA).

Freezing and frozen storage for meat and meat products decreased its physical properties. In addition, binding materials increased the penetration force and hence decrease its sausage elasticity (Jimenez *et al.,* 1996).

Meat emulsions including body skin, wing skin and wing meat were used as binding materials, improve tenderness, juiciness and overall-acceptability. Moreover, they were effective to enhance cooking yield and shear force (Theil *et al.,* 1986). But the skin and meat emulsions contained high fat, collagen, low moisture and crude protein contents (Saleh *et al.,* 2002).

Pectin is widely applied as gelling, thickening and stabilizing agent in the field of food industry. It is a group of designation for those complex colloidal carbohydrate derivatives which occur in, or are prepared from plants (Emam *et al.,* 1994).

Guar gum, really a mucilage, is obtained from the guar seeds *(Cyamposis tetragonoloba)*. It was suitable to form firm gel when compared with standard pectin. In addition, the ability of guar gum to form gel at room temperature was higher than that of pectin (Guindi *et al.,* 1989).

The aim of this study is to evaluate the nutritional value of spent-laying hens meat and preparing different-chicken burger formulas using various natural binding materials such as skin emulsion, pectin, and guar gum. In addition, attempts were carried out to improve physical, chemical and microbiological characteristics of prepared burger samples by using sodium pyrophosphate. Also, the evaluation of the overall quality of burger during freezing-storage period at -18°C for four months was studied.

MATERIALS AND METHODS

Materials:

Habard females (spent-laying hens), about 2 year-old and weighing 4.0-5.0 kgs. were obtained from local market at Cairo. These hens were slaughtered, allowed to bleed for 5 min., boiled for 2 min. at 80°C., cleaned by tap water, deskinned, deboned and trimmed in fat.

Potato starch, onion, garlic, and spices were also purchased from local market at Cairo.

Preparation of burger:

Spices-powder mixtures were prepared as described by Kulshrestha and Rhee, (1996); Moawad and Hemeida, (2002). Their percentages were

56.06 celery, 22.44 cubeb, 11.22 cumin, 5.62 black pepper, 2.24 cardamon, 2.2 clove and 0.22 nutmug.

Five formulas of burger were prepared as follows:The first formula served as control, consisted of 67.5% minced-spent trimmed lean meat (mixtures of breast and thigh with ratio 1:1), minced-spent fat 15.0%, equal mixtures of gizzard and heart 5.0%, potato starch 2.0%, chopped-raw onion 2.7%, minced-raw garlic 0.3%, sodium chloride 2.0%, spices mixtures 0.5% and crushed ice 5.0%. The second formula as control was prepared with adding 0.5% sodium pyrophosphate instead of minced meat. Formulas 3, 4 and 5 were prepared as the second formula with adding 5.0% skin emulsion, 1.0% pectin and 1.0% guar gum instead of minced meat, respectively. The formulations were pressed into burgers (90 g. weight, 10 cm in diameter and 1.3 cm height) by using a Molinex-burger machine, burger samples were packed in polyethylene bags and stored at -18°C for 4 months.

Methods:

Gross chemical analysis (moisture, protein, fat and ash contents) was determined according to the method described by AOAC, (1995). Total carbohydrates were estimated by difference. While total-soluble nitrogen (TSN), soluble protein nitrogen (SPN) and non protein nitrogen (NPN) were determined as the method described by El-Ghrabawi and Dugan, (1965). Thiobarbituric acid reactive substances (TBARs) as mg malonaledhyde/kg flesh and total volatile basic nitrogen (TVBN) as mg/100 g. flesh, respectively were determined according to the procedure reported by Pearson (1981).

Physical evaluation, drip and cooking loss were estimated according to Raharjo *et al.* (1995). Water-holding capacity (WHC) and plasticity were determined according to Wierbicki and Deatherage, (1958).

Total aerobic bacterial counts (TABC) and psychrophilic counts were enumerated on plate-count agar medium as described by ICMSF, (1986). The plates of TABC were incubated at 30°C for 48 hours, while those of psychrophilic counts were incubated at 7°C for 7 days. Sporeforming-bacterial counts were enumerated on plate-count agar after heating at 80°C for 15 min. Total molds and yeasts were counted on malt-extract agar medium (Oxoid Manual, 1982).

Organoleptic tests (color, texture, taste, odor and overall-acceptability) of chicken-burger samples after frying on corn seed oil at 180°C for 2 min. for each side were evaluated by 10 members according to Watts *et al.* (1989). Scores were assigned with 10 being the extremely and one dislike extremely.

Statistical analysis of the obtained data was used according to the method described by Snedecor and Cochran, (1980).

RESULTS AND DISCUSSION

Gross-chemical composition of different spent-hen meats, organs and skin emulsion are illustrated in table (1). The percentages of moisture, protein, lipids, ash and carbohydrates in different parts of fresh-spent hens ranged from 64.4 to 74.5%; 16.9 to 19.2%; 4.6 to 17.1%; 0.83 to 1.2% and from 0.70 to 1.2%, respectively. Such results are in accordance with those reported by Salama *et al.* (1994). Skin emulsion showed significant decrease in both moisture and protein contents; meanwhile, there is a significant increase in total lipids comparing with fresh meat (breast and thigh) and organs (gizzard and hearts). These results are in accordance with those found by Saleh *et al.* (2002). On the other hand, breast contained higher protein and lower-fat contents than thigh. These results were confirmed by Ahmed, (1999).

Table (1): Gross chemical composition of spent hens, organs and skin emulsion (g./100g. fresh weight basis).

Parts of hens / constituents	Fresh meat			Fresh organs		Skin ** emulsion	L.S.D 0.05	L.S.D. 0.01
	Breast	Thigh	Whole spent	Gizzard	Heart			
Moisture	74.5	73.6	74.0	74.4	74.2	64.4*	0.686	0.935
Protein	19.2	18.1	18.5	17.9	17.8	16.9*	0.376	0.512
Fat	4.6	6.7	5.85	5.4	5.7	17.1*	0.211	0.288
Ash	0.96	0.90	0.92	1.2	1.1	0.83	NS	NS
Carbohydrate	0.74	0.70	0.73	1.1	1.2	0.77	NS	NS

** Contained skin and wing meat with ratio 2:1 by weight
NS= not significant difference.

Nitrogenous compounds of spent-hens fresh meat, organs and skin emulsion are shown in table (2). The percentages of TN, TSN, SPN and NPN in different parts of spent-hens ranged (2.70-3.07), (2.0-2.30), (1.56-2.04) and (0.26-0.44) g./100g. (fresh weight basis), respectively. The highest value of TN, TSN and SPN was found in breast and the lowest value was noticed in skin emulsion. This is due to the fact that the breast contains higher protein if compared with other parts as shown in table (1). These results are in accordance with those reported by Saleh *et al.*, (2002). Statistical analysis of TN, TSN and SPN showed that there were significant differences among various parts of spent-hens.

Table (2): Nitrogenous compounds of spent hens, organs and skin emulsion (g./100g. fresh weight basis).

Parts of hens / constituents	Fresh meat			Fresh organs		Skin emulsion	L.S.D 0.05	L.S.D. 0.01
	Breast	Thigh	Whole spent	Gizzard	Heart			
Total nitrogen TN%	3.07	2.90	2.96	2.86	2.85	2.70	0.221	0.301
Total soluble nitrogen TSN%	2.30	2.18	2.28	2.20	2.10	2.00	0.139	0.189
Soluble protein nitrogen SPN%	2.04	1.86	1.94	1.78	1.76	1.56	0.255	0.351
Non protein nitrogen NPN	0.26	0.32	0.34	0.42	0.34	0.44	NS	NS

NS= not significant difference.

Gross-chemical composition of prepared chickin burgers during frozen storage period is found in table (3). The percentages of moisture, protein, fat, ash and carbohydrates were (60.6-61.5%), (16.9-17.3%), (17.2-18.4), (2.20-2.30%) and (1.81-2.10%) g./100g. (fresh weight basis) at zero time of storage, respectively. Statistical analysis for chemical constituents of all burger samples showed that there was no significant differences in both treated and untreated samples with sodium pyrophosphate.

It is worthy to mention that the gross-chemical composition of samples was in the permissible levels according to the Egyptian Standards (E.S., 1991), which reported that moisture content should be 60% as a maximum level, protein 15% as a minimum level and fat 30% as a maximum level. Formula (5) showed higher carbohydrates and ash content as compared with other formulas. This observation might be due to the addition of guar gum to burger during processing.

During freezing-storage period at -18°C., moisture and protein contents were slightly decreased as the time of freezing-storage period increased. In contrast, fat showed an apparent increase at the end of storage period. The same trend of results was found by Habbal, (2000). The treatment by sodium pyrophosphate reduced the loss of moisture and protein contents. Such results are in agreement with those found by Mann *et al.* (1990) and Moawad, (1995).

Table (3): Changes in the chemical composition of prepared-chicken burgers during freezing storage (g./100g. fresh weight basis).

Formula	Storage (months)	Moisture	Protein	Fat	Ash	Carbohydrate
1	0	61.2	17.2	17.5	2.29	1.81
	2	60.7	16.9	18.3	2.30	1.80
	4	60.1	16.4	19.2	2.40	1.90
2	0	61.5	17.3	17.2	2.13	1.87
	2	60.8	17.0	18.0	2.30	1.90
	4	60.2	16.5	19.0	2.37	1.93
3	0	60.6	16.9	18.4	2.20	1.90
	2	60.3	16.3	19.2	2.25	1.95
	4	60.0	16.2	19.4	2.40	2.00
4	0	61.3	17.2	17.2	2.20	2.10
	2	60.9	16.7	18.0	2.29	2.11
	4	60.0	16.6	18.8	2.40	2.20
5	0	61.2	17.3	17.2	2.30	2.00
	2	60.7	16.9	17.8	2.40	2.20
	4	60.1	16.8	18.4	2.49	2.21
L.S.D 0.05	-	NS	NS	NS	NS	NS

NS= not significant difference.

Nitrogenous compounds of prepared-chicken burger during freezing storage are shown in table (4). Total nitrogen, total soluble nitrogen, soluble-protein nitrogen were (2.70-2.77), (2.10-2.18), (1.72-1.81) and (0.36-0.38) g./100g. (fresh weight basis), respectively. Statistical analysis of nitrogenous compounds showed that there were no significant differences in all formulas after immediately processing. Total nitrogen was slightly decreased in all frozen samples at the end of storage period. This decrease could be due to the part of nitrogenous compounds which escaped during thawing.

Total-soluble nitrogen (T.S.N.) is an index of denaturation of protein. TSN of all burger samples was showed no significant decrease as the time of storage proceeds. The same trend of results was reported by Lan *et al.*, (1993) who found that freezing conditions did not affect protein solubility. However, at any given time of freezing storage, it could be noticed that sodium pyrophosphate treatment reduced the loss of protein solubility. Such results were confirmed by Moawad, (1995) and Rehab, (1997). Soluble protein nitrogen (SPN) showed the same trend of results. In contrast, a slight increase in non protein nitrogen (NPN) was observed with increasing the time of freezing-storage period.

Total-volatile nitrogen basis (TVNB) is considered as an index for protein decomposition. It ranged from 10.9 to 11.3 mg/100g (fresh weight basis). There was no significant difference among these formulas after processing. TVNB was significantly increased during freezing storage. These results are in agreement with those obtained by Moawad and Hemeida, (2002). It is worthy to mention that TVNB of all formulas before or after freezing storage were at the permissible level (less than 20 mg/100g. fresh weigh) according to E.S., (1991).

Table (4): Changes in the nitrogenous compounds of prepared-chicken burgers during freezing storage (g./100g. fresh weight basis).

Formula	Storage (months)	Total nitrogen	Total soluble nitrogen	Soluble protein nitrogen	Non protein nitrogen	Total** volatile basis nitrogen
1	0	2.75	2.12	1.75	0.37	11.3
	2	2.70	2.01	1.63	0.38	13.2*
	4	2.62	1.97	1.57	0.40	15.6*
2	0	2.77	2.18	1.81	0.37	11.0
	2	2.72	2.04	1.66	0.38	12.8*
	4	2.64	1.98	1.58	0.40	15.3*
3	0	2.70	2.10	1.72	0.38	11.2
	2	2.61	1.91	1.52	0.39	13.0*
	4	2.59	1.86	1.45*	0.41	15.5*
4	0	2.75	2.15	1.78	0.37	10.9
	2	2.67	2.01	1.62	0.39	12.8*
	4	2.66	1.99	1.57	0.42	15.4*
5	0	2.77	2.17	1.81	0.36	11.0
	2	2.70	2.02	1.64	0.38	12.9*
	4	2.69	1.98	1.58	0.40	15.1*

* Indicate statistical significant differences ($P \leq 0.05$).

** mg/100g. fresh weight basis.

Changes in the physical and chemical properties of prepared-chicken burger during freezing storage at -18°C for four months are recorded in table (5). Drip loss is considered as an index of quality for preserved meat. It ranged from 2.2 to 2.9%. Formula (5) showed the lowest value. This is due to the addition of guar gum. Samples treated with sodium pyrophosphate showed lower percentages of drip loss than the control sample. These results are in agreement with those found by Mann *et al.* (1990) and Moawad, (1995). Freezing storage caused a higher increase in drip loss of all samples. It depends on thawing and freezing conditions (George *et al.*, 1991).

Cooking loss ranged from 19.2 to 21.8%. Formula (5) showed the lowest value. Sodium-pyrophosphate treatment recorded the lowest percentages as compared with the control. These results were confirmed by those obtained by Choi, (1992). Cooking loss was inceased as the time of storage proceeds.

Water-holding capacity (WHC) is considered one of the very important technological properties of meat as it affects the tenderness, juiciness, thawing drip and cooking yield of meat and meat products (Moawad, 1995). However, plasticity is an index of tenderness. Freezing storage caused a decrease in both properties. Sodium pyrophosphate treatment improved either WHC or plasticity. These results were in accordance with those reported by George *et al.* (1991) and Miller *et al.*, (1993).

Malonaldehyde appeared to be the most important products of lipid oxidation (Farouk *et al.*, 1991). TBA values ranged from 0.213 to 0.265 mg malonaldehyde/kg. flesh at zero time. TBA values were highly increased as the time of freezing storage increased. This increase may be due to instability of malonaldehyde produced of lipid oxidation. In addition, microorganisms play an important role in decomposition of malonaldehyde during freezing storage (Munoz *et al.*, 1998 and Rhee *et al.*, 1998). Sodium pyrophospate treatment led to decrease in TBA values of all formulas. This might be due to the interaction with meat protein and producing surface-protein layer, that could act as a barrier for oxygen, consequently a reduction in lipid oxidation during freezing storage had been occurred (Moawad, 1995).

Table (5): Changes in the physical and chemical properties of prepared-chicken burgers during freezing storage.

Formula	Storage (months)	Drip loss (%)	Cooking loss (%)	WHC (Cm^2)	Plasticity (Cm^2)	TBA* value
1	0	2.9	20.8	3.2	2.0	0.265
	2	3.8	22.5	3.0	1.7	0.420
	4	4.8	23.8	2.3	1.3	0.651
2	0	2.5	19.8	3.4	2.1	0.220
	2	3.6	20.6	3.1	1.8	0.396
	4	4.4	22.0	2.4	1.4	0.611
3	0	2.6	21.8	3.1	1.9	0.221
	2	3.5	2[illegible].4	2.8	1.5	0.410
	4	4.4	23.6	2.0	1.2	0.516
4	0	2.4	19.4	3.3	2.0	0.215
	2	3.2	20.2	2.9	1.7	0.398
	4	4.2	21.5	2.2	1.3	0.603
5	0	2.2	19.2	3.4	2.1	0.213
	2	3.1	20.1	3.1	1.8	0.401
	4	4.0	21.2	2.4	1.4	0.612

* TBA per mg malonaldehyde/kg. fresh.

The changes occurring in the microbial load of different uncooked-burger samples prepared from spent-laying hens during storage period at -18°C are tabulated in table (6). It is evident from these results that total aerobic bacterial counts (TABC), psychrophilic counts, sporeforming bacterial counts, total mold and yeast counts were $2.01X10^5$, $4.71X10^4$, $4.11X10^2$ and $3.29X10^3$ CFU/g., respectively at zero time of storage. It is worthy to mention that these counts of all formulas were at the permissible level, of chicken burgers according to E.S., (1991) which recommended that microorganisms count was limited at 10^6 of total bacterial counts.

It is clear that the TABC, psychrophilic bacteria and sporeforming bacteria of all formulas, contained sodium pyrophosphate, was less than control samples indicating that it had an antibacterial effect. These results are in agreement with those found by Chambers *et al.* (1991) and Choi, (1992).

During freezing storage, there was a gradual decrease in the TABC of all formulas under investigation with increment of time storage. This trend of changes was observed with spore-forming bacterial counts; total molds and yeasts. This decrease in all microbial populations might be due to drastic condition of freezing storage. This trend of results was confirmed by Shady, (1999). Results also showed that yeasts and molds are typically more resistant to freezing than bacteria, partly because fungi are generally more tolerant to reduced water activity, aw (Jay, 1996). On the other hand, there was a slight increase in psychrophilic bacteria upon storage period.

Table (6): Changes in the microbiological of uncooked-chicken burger during freezing storage (CFU/g.).

Formula	Storage (months)	Total bacterial counts	Psychrophilic bacterial counts	Spore forming bacteria	Molds and yeasts
1	0	$2.01X10^5$	$4.71X10^4$	$4.11X10^2$	$3.29X10^3$
	2	$4.76X10^4$	$1.76X10^5$	$3.90X10^2$	$3.22X10^3$
	4	$3.69X10^4$	$1.69X10^5$	$3.71X10^2$	$3.11X10^3$
2	0	$9.14X10^4$	$2.22 X10^4$	$4.01X10^2$	$3.21X10^3$
	2	$4.51X10^4$	$8.66 X10^4$	$3.82X10^2$	$3.13X10^3$
	4	$2.85X10^4$	$8.63 X10^4$	$3.68X10^2$	$3.02X10^3$
3	0	$9.03X10^4$	$2.11X10^4$	$4.32X10^2$	$3.22X10^3$
	2	$4.32X10^4$	$8.02X10^4$	$3.96X10^2$	$3.20X10^3$
	4	$2.67X10^4$	$8.01X10^4$	$3.81X10^2$	$3.08X10^3$
4	0	$8.67 X10^4$	$2.91X10^4$	$4.27X10^2$	$3.16X10^3$
	2	$4.35 X10^4$	$7.84X10^4$	$3.82X10^2$	$3.09X10^3$
	4	$2.95 X10^4$	$7.82X10^4$	$3.61X10^2$	$3.01X10^3$
5	0	$9.10 X10^4$	$2.64X10^4$	$4.21X10^2$	$3.17X10^3$
	2	$4.26 X10^4$	$7.86X10^4$	$3.92X10^2$	$3.05X10^3$
	4	$2.61 X10^4$	$7.77X10^4$	$3.60X10^2$	$3.0X10^3$

Sensory evaluation for the cooked spent-hen burgers are shown in table (7). Statistical analysis showed that there was no significant difference in all formulas either before or after freezing storage. Overall-acceptability scores indicated that all burger samples were accepted. Both freezing and cooking methods had no significant effect on sensory properties (Dawood, 1995).

Finally, it could be concluded that spent laying-hens are suitable for preparing burgers with high nutritive value and acceptable, as well as, its low economic value.

Table (7): Organoleptic properties of prepared-chicken burgers during freezing storage.

Formula	Storage (months)	Properties				
		Color	Texture	Odor	Taste	Overall acceptability
1	0	8.1	8.0	8.2	7.8	8.1
	2	8.0	7.8	8.0	7.7	8.0
	4	7.6	7.5	7.8	7.5	7.6
2	0	8.2	8.0	8.2	7.9	8.0
	2	8.1	7.9	8.1	7.8	7.8
	4	7.8	7.6	7.6	7.5	7.6
3	0	8.3	8.1	8.2	7.9	8.1
	2	8.1	7.8	8.0	7.7	8.0
	4	7.7	7.5	7.7	7.5	7.6
4	0	8.4	8.2	8.3	7.9	8.2
	2	8.2	8.0	8.1	7.8	8.0
	4	8.1	7.7	8.0	7.6	7.8
5	0	8.2	8.0	8.1	7.7	8.0
	2	8.0	7.9	7.9	7.6	7.8
	4	7.8	7.6	7.6	7.3	7.6

No significant differences at $P \leq 0.05$

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تقييم صفات الجودة للبرجر المصنع من لحوم أمهات الدجاج

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تعتبر أمهات الدجاج الكبيرة في العمر-البياض خصوصا بعد انتهاء قدرتها على وضع البيض ذات قيمة إقتصادية منخفضة نظراً لخشونة لحومها مما يتعذر معه استهلاكها بصورتها الطبيعية ، لذا صمم هذا البحث للاستفادة من الكميات الكبيرة من الدجاج ذات الأوزان الكبيرة في صناعة البرجر.

تم تقييم جودة البرجر المصنع من أمهات الدجاج الكبير في العمر مع إضافة بيروفوسفات الصوديوم والمواد الرابطة الطبيعية مثل مستحلب الجلد والبكتين وصمغ الجوار وقد دلت النتائج على أن التركيب الكيميائي للحوم أمهات الدجاج يختلف من عضلة لأخري.

إتضح من التركيب الكيميائي لعينات البرجر أنها كانت في حدود المواصفات القياسية المصرية وقد أظهر التخزين بالتجميد إنخفاض نسبة الرطوبة والبروتين وزيادة الدهون والرماد والكربوهيدرات ظاهرياً وقد أدت المعاملة بالبيروفوسفات إلى تقليل الفاقد من البروتينات الذائبة بينما لم تتأثر المكونات الأخري.

زادت نسبة كل من السائل الناضح والفقد بالطهي خلال التخزين بالتجميد وقد أدت المعاملة بالبيروفوسفات إلى تقليل الفاقد في كل منهما علاوة على تحسين القدرة على الاحتفاظ بالماء والبلاستيكية.

ذادت قيمة كل من المركبات النيتروجينية المتطايرة والثيوباريتيوريك خلال فترة التخزين وأظهرت المعاملة بالبيروفوسفات نقصاً واضحاً في كل منهما.

إنخفضت أعداد البكتريا الكلية والمحبة للبرودة والمتجرثمة والفطريات والخمائر خلال فترة التخزين وقد زاد معدل النقص في العينات المعاملة بالبيروفوسفات وكانت الأعداد في نطاق الحدود المسموح بها طبقاً للمواصفات المصرية. كذلك وقد اظهر التقييم الحسي لعينات البرجر بان جميعها كانت مقبولة حسياً.

مما سبق يتضح عدم وجود أي علامات للفساد أو تغير في خواص جودة البرجر محل الدراسة خلال مدة التخزين بالتجميد على درجة -١٨م لمدة ٤ شهور وقد تبين أن العينة رقم (٥) والتي تحتوي على صمغ الجوار من أفضل العينات ولذا ينصح بتصنيعها على نطاق تجاري نظرا لجودتها ورخص ثمنها.