



## Quality Evaluation of Three Types of Fish Pastirma during Frozen Storage

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### ABSTRACT

The main objective of this investigation was to evaluate the quality of three types of fish pastirma prepared from common carp (*Cyprinus carpio* L.), kawakawa (*Euthynnus affinis*) and little tuna (*Euthynnus alletteratus*) during frozen storage at  $-18^{\circ}\text{C}$  for three months. Physicochemical, microbiological and sensory properties of fish pastirma were determined. At zero time the results showed that, the values of pH, TVBN, TMA, TBA and TBC ranged between (4.82-5.42), (10.47-43.89 mg/100g), (2.56-10.70 mg/100g), (0.017-0.111 mg MDA/kg) and (1.23-1.77 log cfu/g); respectively. Also, results indicated that the values of pH, TVBN, TMA and TBA parameter were increased during storage period at  $-18^{\circ}\text{C}$  and all samples did not exceed the maximum permissible levels as determined by the Egyptian Standard Specification for both freshwater and marine fish. *Staphylococcus aureus*, *E.coli*, total coliform were not detected during storage of three types of fish pastirma. In addition, total bacterial count was increased at the first month of storage then decreased till the end of storage but not exceed the MPL reported by ESS. Sensory evaluation did not change significantly ( $p>0.05$ ) in both three types of fish pastirma. The study concluded that the effect of frozen storage at  $-18^{\circ}\text{C}$  on fish pastirma quality properties varied between fish species and depended on the functional properties of fish muscles and all samples gain high organoleptic acceptance as an alternative and cheap product compared to the meat product.

### INTRODUCTION

Seafood is one of the most important food commodities consumed worldwide as a high-quality, healthy, and safe food. However, it can be fast spoiled by bacteria and food-borne pathogens, resulting in spoilage and disease outbreaks with potential hazard effects on human health (Cruz *et al.*, 2015). So that, fish freezing as a highly effective, non-destructive and cost-efficient method of food preservation is the most widely used method for delay oxidation and proteolytic activity to extend the shelf-life and protect the quality properties of fish products (Śmiecińska *et al.*, 2015).

Fish pastirma is dry-cured product with special taste and palatability opportunities which processed through approximately one month by curing, drying, pressing and coating with garlic, paprika, red pepper and water containing paste and again drying (Kok *et al.*, 2009 and Kaban, 2009).

There are very limited numbers of publications regarding to fish pastirma. Yapar, (1992) determined the quality parameters (physical, chemical, microbiological and sensory attributes) of fish pastirma. Arslan, *et al.*, (1997a) produced vacuumed fish pastrami from *Cyprinus carpio*, stored at  $4\pm 1^\circ\text{C}$  for 120 days. Arslan, *et al.*, (1997b) determined the microbiological and chemical properties of vacuumed and un-vacuumed mirror carp (*Cyprinus carpio* L.) pastirma stored at market temperature ( $20^\circ\text{C}$ ) for 120 days. Arslan and Kok, (2001) studied the microbiological and chemical changes in sliced and vacuumed *Barbus esocinus* pastirma during storage at  $4\pm 1^\circ\text{C}$ . Kok and Arslan, (2003) investigated the effect of storage time in cumin paste for 12, 24 and 48 h on the microbiological, chemical and sensorial quality of vacuum packed barbel (*Barbus esocinus*) fish pastirma during storage at  $20^\circ\text{C}$  for 90 day. Kok *et al.*, (2009) studied sensory, chemical and microbiological changes of catfish (*Silurus glanis* L.) pastirma stored at  $20^\circ\text{C}$  for three months. Mahmoud *et al.*, (2016) determined physicochemical, microbiological and organoleptic analysis of common carp (*Cyprinus carpio*) fish pasitrma stored at  $25\pm 2^\circ\text{C}$  for 15 days. Therefore, the aim of this study was focus on production and evaluation the quality of three types of fish pastirma during frozen storage at  $-18^\circ\text{C}$  for three months.

## MATERIALS AND METHODS

### Materials

About 200 kg of common carp (*Cyprinus carpio* L.), Kawakawa (*Euthynnus affinis*) and Little Tuna (*Euthynnus alletteratus*) fresh fish samples were collected from Alexandria fish market, and transported in icebox to Fish Processing and Technology Laboratory, Fish Research Station, El-Kanater El-Khiria, National Institute of Oceanography and Fisheries within 3 hours. Fenugreek flour, salt and spices (red pepper and cumin) were obtained from Cairo local market.

### Methods

#### Processing of fish pastirma

Fish samples prepared under hygienic condition, all fish samples were rewashed, beheaded, eviscerated, skin removed and filleted. Fish pastirma were processed as follows: Fish fillets were rewashed, drained, salted as dry salting for 6 hours (20 g salt/100 g fillet), washing to remove of salt, 1<sup>st</sup> drying at room temperature by hanging fillet, pressing by mechanical compressor, 2<sup>nd</sup> drying at room temperature, coated with ç emen: (50% fenugreek flour, 35% garlic and 15% red pepper and sufficient amount of water) as given by Tekinşen and Doğruer (2000). The coated fillet left until the coated layer complete drying, samples were hanged and left for drying at ambient temperature ( $25^\circ\text{C}\pm 3$ ) for 5-7 days until coated layer was dried and had about 3 mm thickness. Pastirma samples were packed in open polyethylene bags, which divided for storing at  $-18^\circ\text{C}$  and subjected to organoleptic analysis as fried, physicochemical and microbiological analysis (Fig. 1).

#### Analytical methods

##### Physicochemical analysis

Moisture, crude protein, fat, ash contents and pH value were carried out according to the methods recommended by the AOAC (2000). Total volatile basic nitrogen (TVB-N) contents were determined according to the method described by Pearson (1976). While, the thiobarbituric acid (TBA) value was measured according to the method described by Tarladgis *et al.* (1960).

### Microbiological analysis

Ten gram of each sample were aseptically taken into a sterile homogenizer flask (Homogenizer type MPW-302, Poland), to which 90 ml of sterile (0.1%) peptone water diluted were added and homogenized for 2 minutes at 800 rpm to provide a homogenate of  $10^{-1}$  dilution. The homogenate was thoroughly mixed. One ml of homogenate was transferred into a sterile test tube containing 9 ml of 0.1 % peptone water, then ten - fold serial dilution were prepared up to  $10^{-6}$  (Anon, 1978). Total bacterial count, total coliforms count, *Escherishia coli* and *staphylococcus aureus* were determined according to APHA (1992).



Fig. 1: Common carp, kawakawa and little tuna fish pastirma samples.

### Sensory analysis

The sensory characteristics of fried fish pastirma was carried out according to Amerine *et al.*, (1965); it was done in terms of color, tenderness, taste, flavor and overall acceptability. Fish pastirma was evaluated by 10 panelists from National Institute of Oceanography and Fisheries, El-Kanater El-Khiria. A 9 point hedonic scale was employed in this sensory analysis. Samples evaluated as fresh processed pastirma and during storage at  $-18^{\circ}\text{C}$  for three months. The frying process was done in vegetable oil at  $170^{\circ}\text{C}$  for 1 min for all samples by using electric fryer.

### Statistical analysis

All measurements were performed in triplicate and values expressed as the mean  $\pm$  SD. Statistical analyses were performed using SPSS 18.00 for Windows. Analysis of variance (ANOVA) was used and statistical significance was set at  $p < 0.05$  to detect the significant effect between means during storage periods according to (Snedecor and Cochran, 1980).

## RESULTS AND DISCUSSTION

### Chemical composition of fish pastirma

The moisture, protein, lipids and ash of common carp, kawakawa and little tuna fish pastirma at zero time were (50.48, 50.16, 60.82), (38.16, 42.04, 32.53), (5.07, 3.40, 3.39) and (3.51, 3.21, 1.28); respectively (Table 1). Kok *et al.* (2009) found that, moisture, protein, fat and ash contents of catfish pastirma at zero time were (35.66, 39.60, 11.36 and 12.96), respectively, while Mahmoud *et al.* (2016) found that, moisture, protein, fat, ash and carbohydrates contents of common carp fish pastirma at zero time were 51.80, 21.27, 13.38, 8.54 and 1.01%; respectively. During frozen storage moisture contents of common carp, kawakawa and little tuna fish

pastirma decreased from 50.48, 50.36 and 62.82% at zero time to 45.93, 44.23 and 60.34% at the end of storage period; respectively. Protein and lipid contents of common carp, kawakawa and little tuna fish pastirma were increased during the first month of frozen storage then decreased until the end of frozen storage. Ash contents of common carp, kawakawa and little tuna fish pastirma increased during frozen storage from 3.51, 3.21 and 1.28% at zero time to 8.01, 7.70 and 3.82% at the end of storage period; respectively (Fig. 2).

**Table 1: Chemical composition of fresh fish pastirma samples.**

Constitutes	Common carp	Kawakawa	Little Tuna
Moisture (%)	50.48±0.09	50.16±0.32	60.82±0.13
Protein (%)	38.16±0.18	42.04±0.33	32.53±0.41
Lipids (%)	5.07±0.49	3.40±0.16	3.39±0.63
Ash (%)	3.51±0.78	3.21±0.27	1.28±0.46

Data are presented as means ± standard deviation (SD)

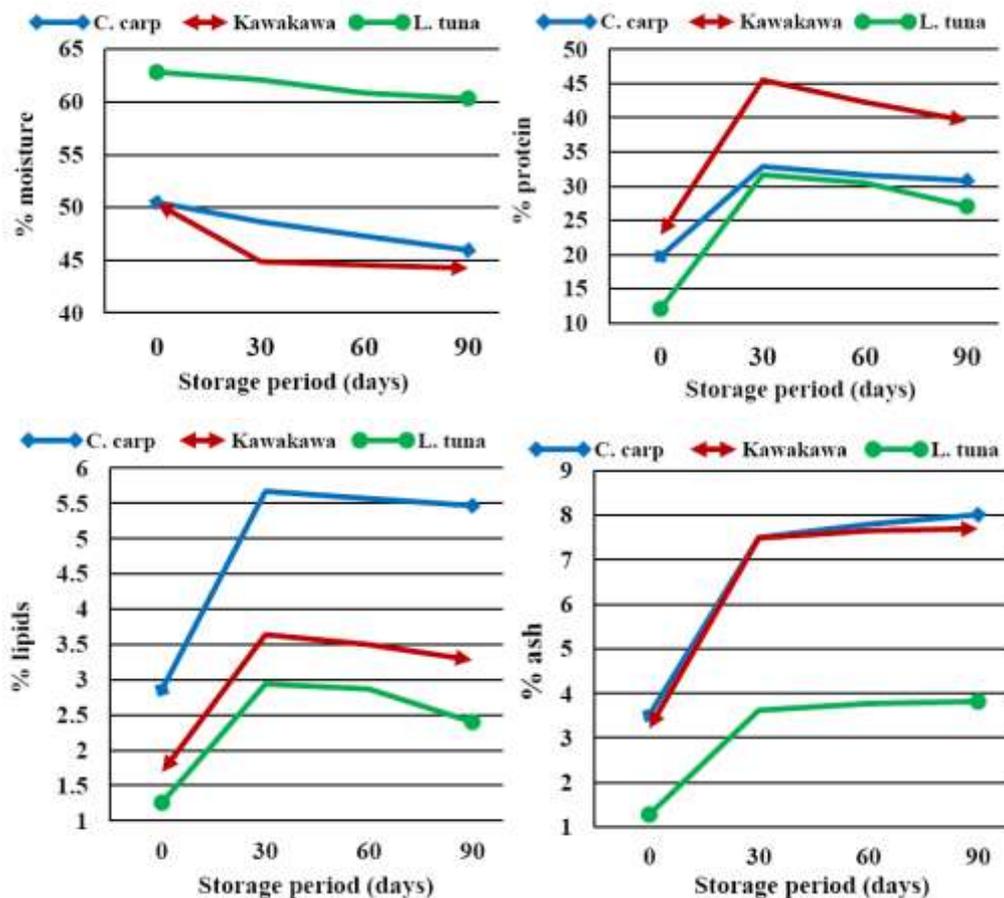


Fig. 2: Effect of frozen storage on chemical composition (% on w/w) of fish pastirma samples.

The obtained results agree with those reported by Mahmoud *et al.*(2016) who found that, moisture content of common carp fish pastirma was decreased from 51.80 at zero time to 40.73% at the end of storage at 25±2°C. While, protein, lipid and Ash contents of common carp fish pastirma were increased from 21.27, 13.38 and 8.54% at zero time to 27.50, and 13.86% at the end of storage at 25±2°C; respectively. On the other hand, Kok *et al.*, (2009) found fluctuation in moisture, protein, lipids and Ash contents during 90 day of storage at 20°C.

### Physicochemical analysis of fish pastirma

The pH, TVBN, TMA and TBA values of common carp, kawakawa and little tuna fish pastirma at zero time were (4.82, 5.38, 5.42), (10.47, 37.17, 43.89 mg/100g), (2.56, 9.14, 10.70 mg/100g) and (0.017, 0.111, 0.030 mg MDA/kg); respectively (Table 2). Kok *et al.*(2009) found that, pH value of catfish pastirma at zero time was (5.72), while Mahmoud *et al.* (2016) found that, pH value, TVBN and TBA of common carp fish pastirma at zero time were 6.4, 15.65 and 0.05; respectively. The pH, TVBN, TMA and TBA values of common carp, kawakawa and little tuna fish pastirma increased during frozen storage till reached to (7.88, 7.94, 8.13), (13.36, 43.96, 49.91 mg/100g), (5.41, 13.35, 14.26 mg/100g) and (0.402, 2.340, 2.360 mg MDA/kg); respectively at the end of frozen storage (Figure, 3). On the other hand, Kok, *et al.*, (2009) found that pH value was decreased from 5.72 at zero time to 5.44 at the end of storage period at 20°C for 90 day. Mahmoud, *et al.*, (2016) found that, pH value of common carp fish pastirma was decreased from 6.51 at zero time to 5.80 at the end of storage at 25±2°C. Also found that, TVBN content of common carp fish pastirma was increased from 15.65 at zero time to 34.80% at the end of storage at 25±2°C. While, TBA values of common carp fish pastirma were fluctuated during storage at 25±2°C.

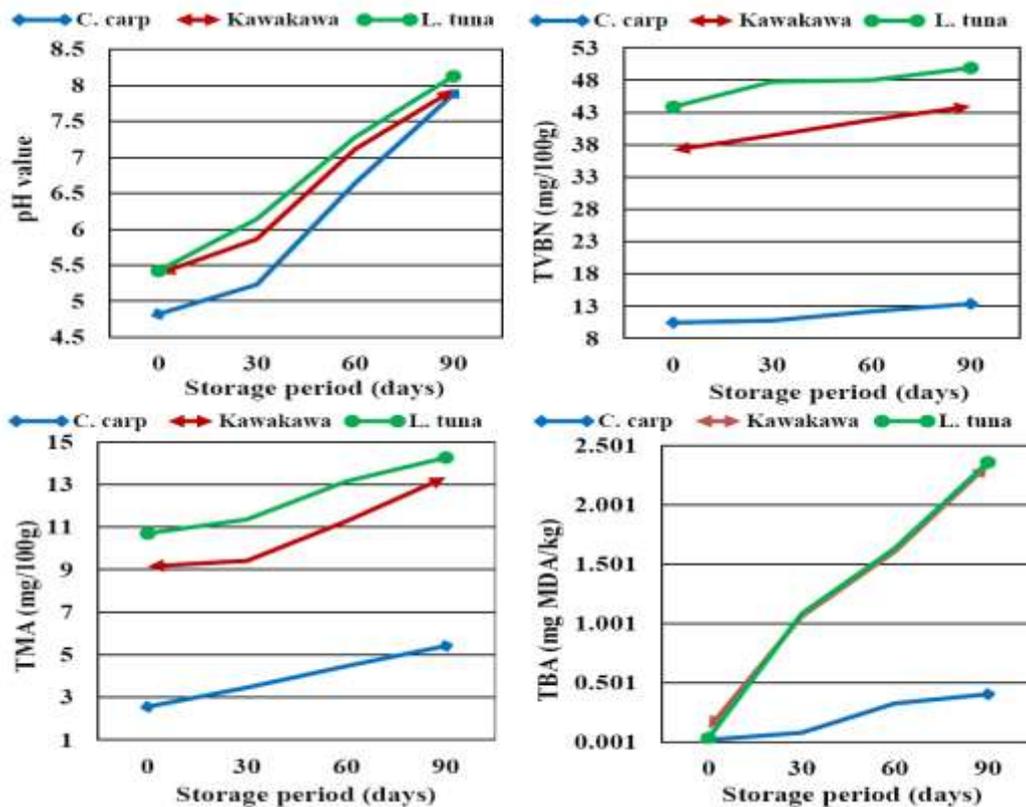


Fig. 3: Effect of frozen storage on physicochemical (on w/w) properties of fish pastirma samples.

### Microbiological analysis of fish pastirma

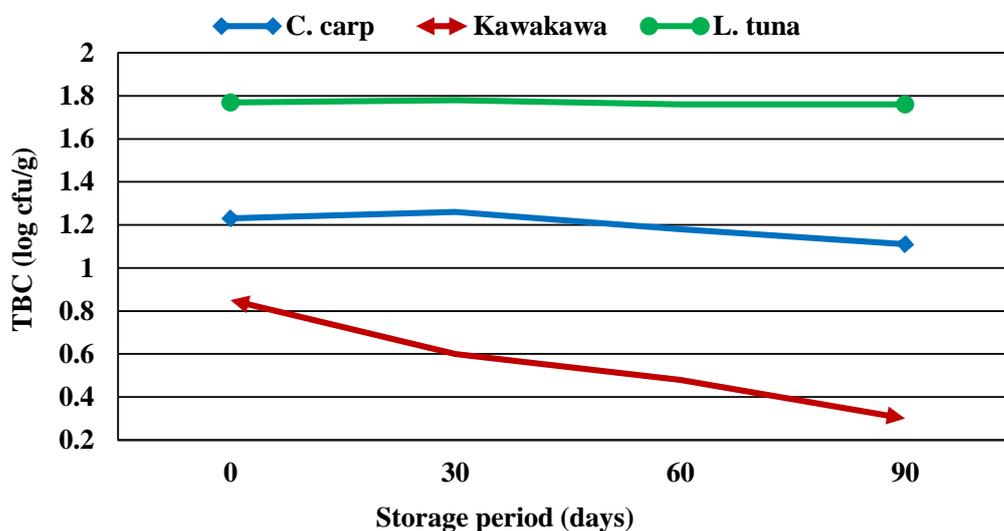
*Staphylococcus aureus*, *E. coli*, total coliform not detected at zero time and during storage of three types of fish pastirma until the end of storage. In addition, total bacterial count (TBC) of common carp, kawakawa and little tuna fish pastirma at zero time were 1.23, 0.85 and 1.77 log cfu/g; respectively (Table 2). TBC of common carp and little tuna fish pastirma increased from 1.23 and 1.77 log cfu/g at the first month of frozen storage to 1.26 and 1.78 log cfu/g then decreased to 1.11 and 1.76 log cfu/g at the end of storage. While, TBC of kawakawa fish pastirma was

decreased from 0.85 log cfu/g at zero time to 0.30 log cfu/g at the end of frozen storage; respectively (Figure 4). In addition, total bacterial count was increased during storage period but not exceed the MPL reported by ESS. Mahmoud *et al.* (2016) who found that, TBC of common carp fish pastirma at zero time was  $9 \times 10^3$  cfu/g.

**Table 2: Physicochemical and microbiological quality criteria of fresh fish pastirma samples**

Parameters	Common carp	Kawakawa	Little Tuna
pH value	4.82±0.03	5.38±0.03	5.42±0.06
TVBN (mg/100g)	10.47±0.47	37.17±0.28	43.89±0.17
TMA (mg/100g)	2.56±0.16	9.14±0.11	10.70±0.14
TBA (mg MDA/Kg)	0.017±0.003	0.111±0.009	0.03±0.011
TBC (log cfu/g)	1.23	0.85	1.77
<i>Staphylococcus aureus</i>	nd	nd	nd
<i>E.coli</i>	nd	nd	nd
Total coliform	nd	nd	nd

Data are presented as means ± standard deviation (SD)



**Fig. 4: Effect of frozen storage on TBC (log cfu/g) of fish pastirma samples.**

### Sensory characteristics of fish pastirma

Sensory evaluation was carried out after frying process of fish pastirma. The mean values of appearance, flavor, taste, tenderness, juiciness and overall acceptability of different types of fish pastirma indicated that common carp fish pastirma was the best type > kawakawa fish pastirma > little tuna fish pastirma (Table, 3). Figure (5) showed the changes of appearance, flavor, taste, tenderness, juiciness and overall acceptability of fish pastirma processed from common carp, kawakawa and little tuna during storage at  $-18^{\circ}\text{C}$  for 90 days.

**Table 3: Sensory evaluation of fish pastirma samples**

Parameters	Common carp	Kawakawa	Little Tuna
Appearance	9±1.14	8±0.89	7±0.73
Flavor	9±0.75	8±0.80	7±1.03
Taste	9±1.16	8±0.99	7±1.12
Tenderness	9±1.17	8±1.41	7±0.94
Juiciness	9±1.29	8±1.06	7±0.88
Overall acceptability	9±0.94	8±0.83	7±1.03

Data are presented as means ± standard deviation (SD).

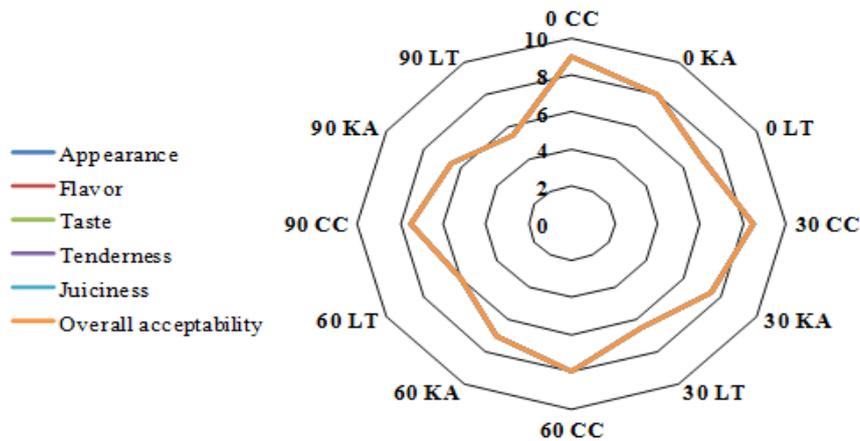


Fig. 5: Effect of frozen storage on sensory evaluation of fish pastirma samples. CC: Common Carp; KA: Kawakawa and LT: Little Tuna.

The obtained results explained the same trend of sensory parameters during frozen storage and pastirma processed from common carp was the best type followed by kawakawa and little tuna fish.

## CONCLUSION

The study concluded that the fish pastirma produced from common carp, kawakawa and little tuna fish gain high organoleptic acceptance as an alternative and cheap product compared to meat and the common carp fish pastirma the best type followed by kawakawa and little tuna. Effect of frozen storage at  $-18^{\circ}\text{C}$  for three months on the fish pastirma quality properties varied between fish species and depended on the functional properties of fish muscles.

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## ARABIC SUMMARY

## تقييم جودة ثلاثة أنواع من بسطرمة السمك أثناء التخزين بالتجميد

محمد أبوظالب، عبدالرحمن سعيد تغلب، محمد عبدالهادى إبراهيم، فيفي راغب أنيس، مها إسماعيل جنيّة، مصطفى مصطفى محمود، شيماء محمد أبوظالب  
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تهدف هذه الدراسة إلى إنتاج وتقييم جودة ثلاثة أنواع من بسطرمة السمك المصنعة من أسماك المبروك العادى والبلاميطة والكبريت أثناء التخزين بالتجميد على -١٨م لمدة ثلاثة شهور. وقد تم تقدير الخصائص الفيزيائية والكيميائية والميكروبيولوجية والحسية لعينات بسطرمة السمك المصنعة الطازجة والمجمدة أثناء التخزين لمدة ثلاثة أشهر. وقد أظهرت النتائج المتحصل عليها أن قيم كلا من الأس الهيدروجيني والنيتروجين الكلى المتطاير وثلاثى ميثيل الأمين وحامض الثيوباربتوريك والعدد الكلى للبكتريا عند بداية فترة التخزين فى عينات البسترمة الطازجة تراوحت من (٤.٨٢-٥.٤٢)، (٣.٨٩-١٠.٤٧ ملجم/١٠٠جم)، (١٠.٧٠-٢.٥٦ ملجم /١٠٠جم)، (٠.١١١ - ٠.٠١٧ ملجم مالونالدهيد/كجم)، (١.٢٣-١.٧٧ للوغاريتم العدد الكلى للبكتريا) على الترتيب. وأظهرت النتائج حدوث زيادة فى كلا من قيم الأس الهيدروجيني والنيتروجين الكلى المتطاير وثلاثى ميثيل الأمين وحامض الثيوباربتوريك خلال التخزين بالتجميد على درجة حرارة -١٨م فى جميع عينات بسطرمة السمك المخزنة ولكن لم تتعدى جميع القيم المتحصل عليها الحدود القصوى المسموح بها فى المواصفات القياسية المصرية لأسماك المياه العذبة وأسماك المياه المالحة. وأوضحت نتائج الفحص الميكروبيولوجى عدم ظهور أو وجود أى نوع من أنواع البكتريا الأتية *Staphylococcus aureus*, *E.coli*, total coliform فى جميع عينات البسترمة المصنعة الطازجة والمخزنة بالتجميد على -١٨م أثناء فترة التخزين بالكامل بينما أظهرت النتائج زيادة العدد الكلى للبكتريا خلال الشهر الأول من التخزين ثم إنخفاضه تدريجيا حتى نهاية فترة التخزين ولكن لم تتعدى جميع القيم المتحصل عليها الحدود القصوى المسموح بها فى المواصفات القياسية المصرية. كما أوضحت نتائج التقييم الحسى للثلاثة أنواع المصنعة من البسترمة عدم وجود فروق معنوية بين الثلاثة أنواع فى الحالة الطازجة وأثناء التخزين. وقد خلصت الدراسة إلى أن تأثير التخزين بالتجميد على درجة حرارة -١٨م على خصائص جودة بسطرمة السمك يختلفت تبعا لنوع السمك المصنعة منه البسترمة كما يعتمد على الخصائص الوظيفية لعضلات هذه الأسماك وحظيت جميع عينات بسطرمة السمك المصنعة بقبول حسي مرتفع كمنتج بديل منخفض التكلفة مقارنة بالمنتج المصنع من اللحوم.