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STORAGE STABILITY AND QUALITY EVALUATION OF FISH PATTIES PRODUCED FROM COMMON CARP AND CATFISH FLESH

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Abstract

Fresh catfish (*Clarias gariepinus*) and common carp (*Cyprinus carpio*) fishes have been processed to fish patties, by adding various additives. , they were stored in a refrigerator at 4 ±1 ºC. Storage stability and quality evaluation of fish patties from each species stored at 4 ± 1°C were determined. Sensory properties (colour, odour, flavour and texture), chemical properties (pH, total volatile base nitrogen (TVB-N), trimethyl-amine (TMA) and thiobarbituric acid (TBA) and microbiological properties (total bacterial count (TBC), psychrophilic bacteria, total yeast, total mould count of fish patties was periodically determined. According to sensory evaluation, chemical quality attributes and microbiological quality criteria, catfish and carp patties became unfit for human consumption at the 10 and 8th days of cold storage, respectively. Effect of storage time on the sensory scores, values of pH, TVB-N, TMA, TBA, TBC, psychrophilic bacteria total yeast and total mould of patties was found significant. It could be concluded that catfish and common carp fish are good sources for producing fish patties. So, it can be increased their marketing value.

Keywords: Common carp, catfish and patties

INTRODUCTION

Fish has long been recognized as a valuable source of high-quality protein in the human diet. In recent years, fish lipids have also assumed great nutritional significance, because of their high polyunsaturated fatty acid levels, which can reduce blood LDL

cholesterol and have antithrombotic, anti-inflammatory, antiarrhythmic and vasodilatory properties (Puwastien *et al.*, 1999).

The majority of locally caught karmout (catfish) is distributed in ice and mainly sold fresh. Karmout has low market value as compared to other species of fresh water fish. It has many undesirable characteristics such as rapid development of rancid off-flavour and changes in colour, (Thed *et al.*, 1993). Carp species are widely cultivated family in Egypt and worldwide because of their tolerance of wide differences in pond temperature and water quality, their ease of management, and their high growth rates. (Abdel-Tawwab *et al.*, 2013).

Common carp fish is one of the most important fresh water fish in Egypt. Unfortunately it does not appeal much to the Egyptian consumer as for its unfamiliar appearance, presence of fine bones in its flesh and less appetizing taste if compared to the most popular and delicious fish species well known in Egypt. Thus, a need was felt to develop some convenience products from the meat of the low commercial value fishes to enhance their consumer acceptability.

Bogustkaya and Naseka (1996) reported that consumption of processed seafood is very required and beneficial in terms of preservation and storage of product, further utilization from products and enhancing the employment Opportunities, reducing environmental pollution, recovery of waste and providing easiness for consumer

The demand for ready-to-cook meals is gradually growing owing to their convenience. Among food items, fish products are very popular. Fish patties are ready-to-cook foods and are produced from various fish species. Patties is a value-added fish product which has interesting sensory properties and which can be made from different ingredients (Le Ba and Zuber, 1996). It is not common to consume fish patties in Egypt which fish are generally consumed fresh.

The aim of this work was to elaborate fish patties from common carp and catfish flesh (species of low commercial value) to increase their marketing value and evaluate their quality during cold storage.

MATERIALS AND METHODS

Raw material:

Fresh catfish (*Clarias gariepinus*) and common carp (*Cyprinus carpio*) fishes were obtained from the production ponds of Central Laboratory for Aquaculture at Abbassa, Abu-Hammad district, Sharkia Governorate, Egypt. The fishes were transported directly after catching to the laboratory. On arrival at the laboratory, quality control analyses of the fish were performed and patties were prepared.

Patties preparation:

The fishes were beheaded, gutted, skinned and washed. Headed and gutted fish were boiled in boiling water for 2–3 min. Bones of the fishes were picked up and then fish flesh were minced using a kitchen blender. Ingredients were added to the minced fish according to the following formulation: 0.7% salt, 6% mashed potatoes, 0.9% bread, 4% onion, 0.5% cumin, 0.4% black pepper, 0.5% thyme, 5% red pepper, 1% egg. Minced fishes and ingredients were mixed thoroughly, shaped by hand and coated with wheat flour. Patties were placed into plastic boxes, wrapped with stretch film and stored in a refrigerator (4 ±1 ºC), Pinar *et al*. (2005).

Analysis:

Quality control analyses of patties were conducted during cold storage every two days intervals until they became unacceptable for human consumption and rejection of samples were based on the visual observation of mould growth.

Chemical analysis:

The moisture, protein, fat and ash contents were determined according to A.O.A.C. (2002). Total carbohydrates were calculated by difference according to the Egan *et al.* (1981).

The total volatile basis nitrogen and trimethyleamine were determined according to the method of AMC (1979). Thiobarbituric acid test was carried out using the method of Tarladgis *et al.* (1960). pH value was determined according to the method of Carballo *et al.* (1995).

Microbiological analysis:

Total bacterial (TBC); and psychrophilic bacterial counts were determined as recommended by the APHA (1992) using plate count agar medium. Mould and yeast were counted on Oxytetracycline Yeast extract Agar medium according to Oxoid manual (1982). *Staph. aureus* was enumerated by the method of Baird Parker (1962) using Baird – Parker Agar medium. Coliform group was counted on Violet Red Bile Agar medium using pour plate technique (Oxoid, 2006).

Sensory evaluation:

Taste panels were composed of six members. Patties samples were fried sunflower oil before being presented to the panelists. After frying for 4 min., they were cooled to 50°C and samples were served to panelists for evaluation of the sensory attributes (appearance, odour, flavor and texture). The evaluation was made by giving scores between (1-5) and indicated as: Very good (5), Good (4), Acceptable (3), Bad (2), and Very bad, (1) Kaba *et al.* (2012).

Statistical analysis:

One-way analysis of variance (ANOVA) was used and means comparison was performed by Duncan's multiple range tests (Steel and

Torrie, 1980). Statistical analysis was carried out using SPSS statistic program (Version 10.0) for Windows (SPSS Inc. Chicago, IL).

RESULTS AND DISCUSSION

Mean values for the proximate chemical composition, chemical quality attributes and microbiological aspects of catfish flesh; catfish patties; common carp fish flesh and common carp fish patties are given in Table (1). For raw catfish flesh the moisture, protein, fat, ash and carbohydrates were 76.91, 71.20, 22.87, 3.81 and 2.12 %, respectively, while for raw common carp fish moisture, protein, fat, ash and carbohydrates were 77.70, 79.52, 13.59, 2.27 and 4.52 %, respectively. Chemical quality attributes of catfish and common carp fish are tabulated in Table (1). For raw catfish TVBN, TMA, TBA and pH were 6.46 (mg N /100g), 0.33 (mg N /100g), 0.38 (mg malonaldehyde/kg) and 6.50, respectively, however for common carp fish were 11.83 (mg/100g), 0.46 (mg/100g), 0.47 (mg/kg) and 6.65, respectively. Microbiological aspects are shown in the same Table. Results of chemical quality attributes and microbiological aspects showed that raw fishes were in very good quality according to ICMSF (1978); Varlik *et al.* (1993) and European Union (1995).

The same Table also showed the mean values for the proximate chemical composition, chemical quality attributes and microbiological aspects of catfish patties and common carp fish patties. For catfish patties the moisture, protein, fat, ash and carbohydrates were 69.94, 63.21, 17.88, 3.52 and 15.39 %, respectively, while for common carp fish patties the moisture, protein, fat, ash and carbohydrates were 73.11, 62.32, 8.69, 2.18 and 26.77 %, respectively. Chemical quality attributes of catfish and common carp fish patties are tabulated in Table (1). For catfish patties the TVBN, TMA, TBA and pH were 05.76 (mg/100g), 0.20 (mg/100g), 0.23 (mg/kg) and 6.42, respectively, however for common carp fish patties values were 10.37 (mg/100g), 0.42 (mg/100g),

0.12(mg/kg), 6.45, respectively. Microbiological aspects are represented in the same Table.

Table 1. Chemical composition, chemical quality attributes and microbiological aspects of fish flesh and fish patties.

Parameter \ Fish	Catfish	Catfish patties	Common carp	Common carp patties
Chemical composition				
Moisture	76.91±0.06^{a}	69.94±0.03^{b}	77.70±0.06^{A}	73.11±0.07^{B}
Protein*	71.20±0.05^{a}	63.21±0.11^{b}	79.52±0.04^{A}	62.32±0.08^{B}
Fat*	22.87±0.04^{a}	17.88±0.06^{b}	13.59±0.05^{A}	8.69±0.06^{B}
Ash*	3.81±0.05^{a}	3.52±0.07^{b}	2.27±0.09^{A}	2.18±0.0,08^{B}
Carbohydrates*	2.12±0.06^{a}	15.39±0.08^{b}	4.52±0.06^{A}	26.77±0.08^{B}
Chemical quality attributes				
TVBN (mg/100g)	6.46±0.05^{a}	5.76±0.10^{b}	11.83±0.06^{A}	10.37±0.1.5^{B}
TMA(mg/100g)	0.33±0.04^{a}	0.20±0.04^{b}	0.46±.04^{A}	0.42±0.04^{B}
TBA (mg /kg)	0.38±0.04^{a}	0.23±0.09^{b}	0.47±0.03^{A}	0.12±0.06^{B}
pH	6.65±0.03^{a}	6.42±0.29^{b}	6.50±0.03^{A}	6.45±0.32^{B}
Microbiological aspects				
Log_{10}TBC	4.53±0.20^{b}	4.95±0.4^{a}	4.48±0.06^{A}	4.82±0.06^{A}
Log_{10} Psychrophilic	2.46±0.14^{a}	2.49±0.09^{a}	2.41±0.05^{A}	2.46±0.05^{A}
Log_{10}Yeast	2.32±0.11^{b}	2.50±0.04^{a}	2.34±0.07^{B}	2.60±0.06^{A}
Log_{10} Mold	2.19±0.08^{b}	2.31±0.04^{a}	1±0.05^{A}	2.11±0.09^{B}
Coliform group	ND	ND	ND	ND
S. aureus	ND	ND	ND	ND

Means in rows with different superscripts are significantly different within each fish species ($p<0.05$). by Duncan's multiple range test

ND: not detected

* calculated in dry weight basis

Total Volatile Bases Nitrogen (TVB-N) is widely used as an indicator for fish deterioration Olafsdottir *et al.* (1997) which produced

from degradation of proteins and non protein nitrogenous compounds, mainly as a result of microbial activity **Connell (1975).**

Table 2. Total volatile Basic Nitrogen (TVBN) mg N/100 g of catfish and common carp fish patties during cold storage at 4 ± 1 ºC.

Storage period (days)	Catfish patties	Common carp patties
0	5.76 ± 0.02 ^{f}	10.37± 0.03 ^{e}
2	10.33 ± 0.03 ^{e}	16.18± 0.03 ^{d}
4	17.09± 0.08 ^{d}	23.92 ± 0.02 ^{c}
6	24.39 ± 0.06 ^{c}	31.38 ± 0.03 ^{b}
8	29.81± 0.03 ^{b}	42.15 ± 0.04 $^{a®}$
10	39.13± 0.02 $^{a®}$	®

Means in columns with different superscripts are significantly different ($p<0.05$). by Duncan's multiple range test
® rejected

The initial TVB-N value in the catfish and carp patties was 5.76 and 10.37 mg/100 g respectively, (Table 2). These values increased progressively significantly throughout cold storage ($p>0.05$) until day 10 and 8 of storage for cat fish patties and carp patties respectively which reached the legal limits set for these indexes at 35 mg/100 g for TVB-N European Union (1995). According to Varlik *et al*. (1993) seafood was evaluated as ‘very good’, if TVB-N value is lower than 25 mg/100 g; ‘good’, if TVB-N value is between 25-30 mg/100 g, ‘marketable’, if TVB-N value is between 30-35 mg/100 g and ‘spoiled’, if TVB-N value is 35 mg/100 g or higher than this value. Kilinc *et al.* (2008) reported that TVB-N value of sardine patties was 13.66 mg/100 g at the first day of storage period, and then it was 29.55 mg/100 g at the end of the storage period (at day 6 th). Kaba *et al.* (2012) stated that TVB-N values increased significantly ($p<0.05$) during cold storage of anchovy patties.

Table 3. Trimethyle Amine (TMA mg N/ 100g) of catfish and common carp fish patties during cold storage at 4 º C ± 1.

Storage period (days)	Catfish patties	Common carp patties
0	0.20 ± 0.04 [f]	0.42 ± 0.02 [e]
2	1.31± 0.03 [e]	1.62 ± 0.02 [d]
4	2.81± 0.02 [d]	3.54 ± 0.02 [c]
6	5.71±0.01 [c]	8.77 ± 0.02 [b]
8	9.10± 0.02[b]	14.50 ± 0.01 [a] ®
10	13.58± 0.02 [a]®	®

Means in columns with different superscripts are significantly different (p<0.05). by Duncan's multiple range test
® rejected

Table (3) shows the results of Trimethyle Amine Nitrogen (TMA) of the examined patties. A significant differences in TMA of catfish and carp patties samples throughout the cold storage period were observed, which were 0.20 and 0.42 at zero time of storage ,respectively, and increased significantly during storage period to 13.58 and 14.50 mg N/100g at the day 10 and 8 of storage period respectively. TMA is produced by the decomposition of trimethylamine N-oxide caused by bacterial spoilage and enzymatic activity Taskaya *et al.* (2003)

TBA test is a widely used indicator for the assessment of degree of lipid oxidation Papadopoulos *et al.* (2003). The TBA results are presented in Table (4). The initial TBA values were 0.23 and 0.12 mg malonaldehyde / kilogram of the catfish and carp fish patties samples respectively, and increased significantly during storage period (p<0.01) to 5.19 and 4.89 mg/kg on day 10 and 8 of cold storage period respectively. This increase indicated that oxidative deterioration of lipid into the end products (malonaldehyde) occurred during storage. The most common cause of oil deterioration is oxidative rancidity .Oxidation of the oil, in oily fish, gives rise to rancid odours and flavours; these can limit the storage life of such species more quickly than the protein changes that

govern the extractable protein value Dzudie *et al.* (2004). These results are in good agreement with those obtained by Kaba *et al.* (2012) who showed that the initial TBA value of anchovy patties was 1.37 mg MA/kg, at the end of the storage period of 8 days, TBA values of anchovy patties was found to be 6.78 mg MA/kg.

Table 4. Thiobarbituric acid (TBA) (mg malonaldehyde/ kg) of catfish and common carp fish patties during cold storage at 4 ± 1 º C.

Storage period (days)	Catfish patties	Common carp patties
0	0.23 ± 0.02 ^{f}	0.12 ± 0.03 ^{e}
2	0.79± 0.02 ^{e}	0.38± 0.03 ^{d}
4	1.90 ± 0.02 ^{d}	1.08± 0.05 ^{c}
6	2.88± 0.02 ^{c}	2.59 ± 0.02 ^{b}
8	4.11± 0.02 ^{b}	4.89± 0.03 ^{a} ®
10	5.19 ± 0.03 ^{a} ®	®

Means in columns with different superscripts are significantly different (p<0.05). by Duncan's multiple range test
® rejected

Table 5. pH values of catfish and common carp fish patties during cold storage at 4 º C ± 1.

Storage period (days)	Catfish patties	Common carp patties
0	6.42± 0.02 ^{e}	6.45 ± 0.04^{e}
2	6.48± 0.02 ^{ed}	6.63 ± 0.02 ^{d}
4	6.54± 0.02 ^{d}	6.71 ± 0.02 ^{c}
6	6.71± 0.03 ^{c}	6.81 ± 0.02 ^{b}
8	6.82± 0.02 ^{b}	6.91 ± 0.02 ^{a}®
10	6.90 ± 0.01 ^{a}®	®

Means in columns with different superscripts are significantly different (p<0.05). by Duncan's multiple range test
® rejected

The pH values in relation to the storage time are shown in Table (5). The initial pH values were 6.42 and 6.45 for catfish and carp fish patties samples respectively. During refrigerated storage at 4 ±1 ^{o} C the pH values of patties samples increased significantly reaching 6.90 and 6.91, at the day 10 and 8 of storage for catfish and carp patties respectively. This increase in the pH may be due to the enzymatic degradation of the fish muscle. These results agree with Kaba *et al.* (2012) who found that the pH levels of anchovy patties increased from 6.37 to 6.80 at the end of the storage period of 8 days.

The initial microbiological quality is very important for the shelf life of fish products. Total bacterial count is an important criterion for quality evaluation. As may be expected, the increase in storage time produced significant proliferations in total bacterial count (TBC). The average initial total bacterial count in the examined fish patties samples were 4.95 and 4.82 log cfu/g for catfish and carp patties respectively, (Fig.1). A gradual increase was happened during cold storage period which reached the maximum permissible limit (MPL) for TBC recommended (7.48 and7.46 log $_{10}$ cfu/ g for catfish patties and carp fish patties) at the day 10 and 8, respectively. The maximum acceptable count for fresh water fish is 10^7 cfu/g (7 log $_{10}$) as recommended by ICMSF (1978).

These results were in agreement with Berna *et al.* (2008) who studied, the quality changes in sardine patties stored at 4 ºC and found that TBC of sardine patties increased from 2.50 log cfu/g, to 6.15 log cfu/g, on day 6, similar results were found with Shawki *et al.* (2012) who found that the total bacterial count of silver carp fish ball significantly increased during cold storage.

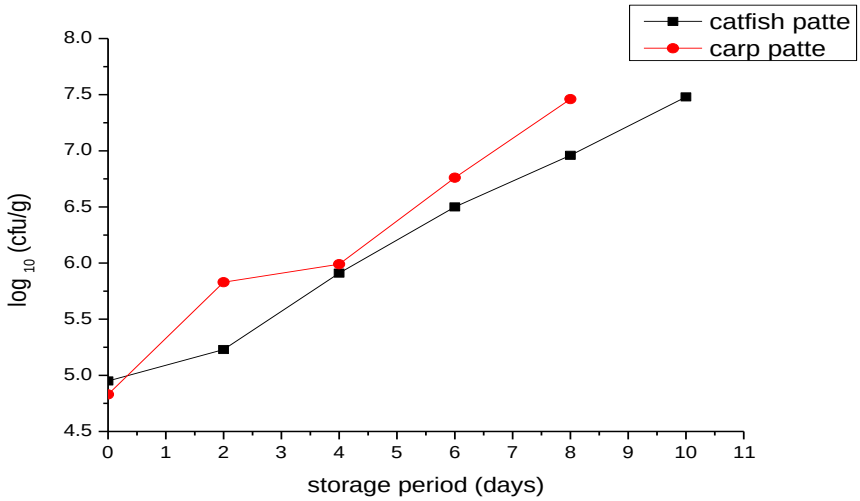

Fig. 1. Total bacterial count of catfish and common carp patties during cold storage at 4 ± 1 º C.

Pseudomonas *spp*. have been incriminated as the main spoilage bacteria in fish stored in ice mainly because of their short generation time Papadopoulos *et al.* (3003).

The changes in psychrophilic bacteria count of catfish and carp fish patties during cold storage are illustrated in Fig. (2). Initial psychrophilic bacteria count of catfish and carp patties were 2.49 and 2.46 log cfu/g, respectively. During storage psychrophilic bacteria count were increased to 5.69 and 5.83 log $_{10}$ cfu/g for catfish and carp patties, at the day 10 and 8, respectively.

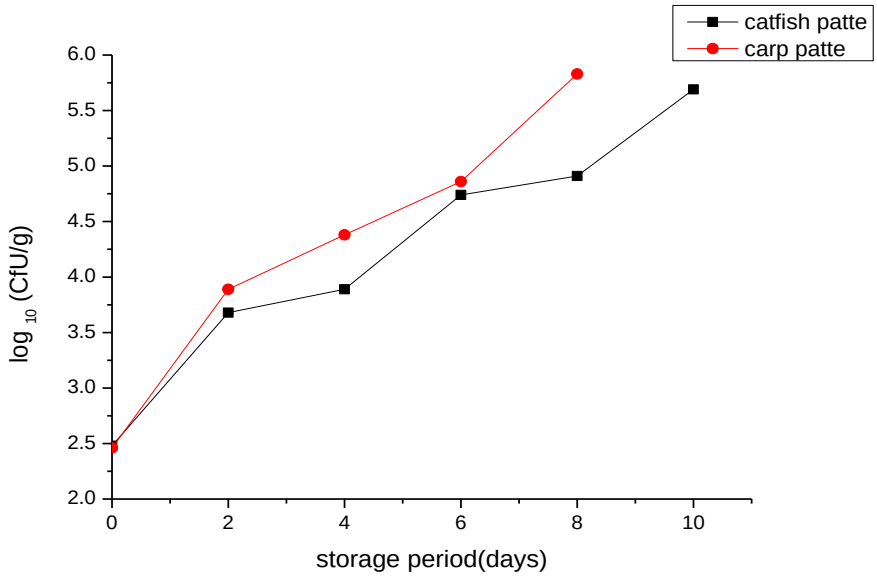

Fig. 2. Psychrophilic bacteria count of catfish and common carp patties during cold storage at 4 ± 1 º C.

In fig (3) It could be noticed that the total yeast count in all patties samples were increased and reached the borderline of acceptability at 10 and 8 days (4.25 and 4.69 log cfu/g) for catfish and carp patties, respectively. These results agree with Kaba *et al.* (2012) who showed that total yeast-mold was 4.51 log cfu/g. and significantly increased to 6.56 log cfu/g at day 8 of storage.

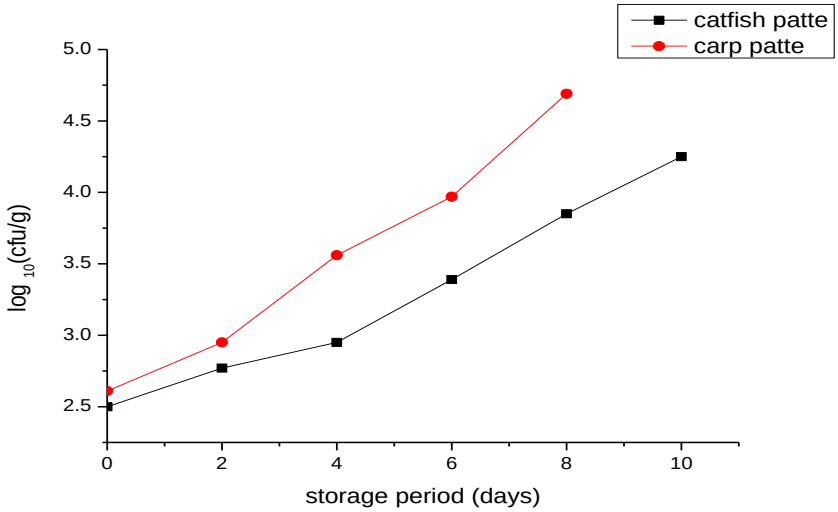

Fig. 3. Yeast count of catfish and common carp patties during cold storage at 4 ± 1 ° C.

Fig (4) represented mould counts of catfish and carp patties. It could be noticed that the initial log count of patties samples were 2.31 and 2.11 log cfu/g, respectively. Gradually increment was happened during cold storage of fish patties samples reached 3.04 and 3.53 log cfu/g. At this stage the samples were completely rejected because of the appearance of spots as a result of mould growth on the surface of the samples. These results are in good coincide with Kaba *et al.* (2012).

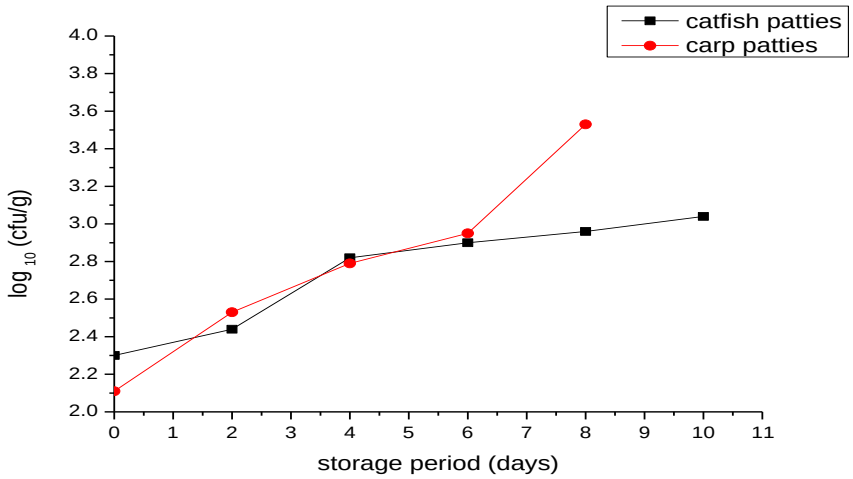

Fig. 4. mould count of catfish and common carp patties during cold storage at 4 ° C ± 1.

The most important criteria for the quality of product for the storage of food are sensory analysis results. A product cannot be marketed unless sensory analysis results are favorable Uzunlu and Yildirim (2003). Regarding to sensory scores of patties samples Tables (6 and 7) it could be seen that sensory scores of fish patties samples decreased significantly during cold storage. Catfish and carp fish patties samples had "very good" quality up to 2 days and "acceptable" quality up to 8 days for catfish patties and 6 days for carp patties. The samples were unfit for human consumption at 10 days for catfish patties and 8days for carp patties. The probable reason of these differences is thought to be differences in the quality of the raw material.

These findings are in agreement with the results described by Pinar *et al.* (2004) and Kaba *et al.* (2012) they found that Sensory scores of anchovy patties decreased significantly throughout cold storage period and were unfit for human consumption at 6 and 8 days.

Table 6. Sensory evaluation of catfish patties during cold storage at 4±1°C.

Parameter	Storage period (days)					
	0	2	4	6	8	10
Appearance	4.99±0.01 [a]	4.08±0.33 [b]	3.15±0.16[c]	2.56±0.07[d]	2.17 ±0.12 [d]	1.39±0.21[e]
Odour	4.98±0.01 [a]	4.55±0.06 [b]	4.34±0.07[c]	4.05±0.03[d]	2.43±0.05[e]	1.44±0.03 [f]
Flavour	4.98± 0.01 [a]	4.54±0.06 [b]	4.34 ±0.07[c]	4.02±0.03[d]	2.40 ±0.30 [e]	1.39±0.15 [f]
Texture	5.00± 0.00 [a]	4.57±0.07 [b]	4.23 ± 0.07 [c]	4.05±0.09 [c]	2.66 ±0.03[d]	1.60± 0.03 [e]
Avarage	4.99	4.44	4.02	3.67	2.42	1.46
Quality	Very good	Very good	Good	good	acceptable	Very bad

Means in raws with different superscripts are significantly different ($p<0.05$). by Duncan's multiple range test.

Table 7. Sensory evaluation of common carp patties during cold storage at 4 ±1°C.

Parameter	Storage period (days)				
	0	2	4	6	8
Appearance	4.86 ±0.13 [a]	3.98 ±0.36 [b]	3.16 ±0.40 [c]	2.21 ±0.06 [d]	1.06 ±0.03 [e]
Odour	4.91±0.02 [a]	4.20±0.11 [b]	3.85±0.21 [c]	3.1±0.08 [d]	1.21±0.06 [e]
Flavour	4.91±0.02 [a]	4.20±0.11 [b]	3.85±0.21 [c]	3.01±20[d]	1.01±0.28 [e]
Texture	4.94± .03 [a]	4.45±0.05 [b]	4.04± .05 [c]	3.04±0.03 [d]	1.35± 0.26 [e]
Avarage	4.91	4.21	3.73	2.84	1.16
Quality	Very good	Very good	Good	acceptable	Very Bad

Means in raws with different superscripts are significantly different ($p<0.05$). by Duncan's multiple range test .

CONCLUSION

Catfish and common carp fish are good sources for producing fish patties. So it can be increased their marketing value. The quality of these kinds of products depends on the quality of the raw material and storage conditions. Shelf life of catfish and common carp patties in refrigeration conditions at 4 ºC ±1was determined as 8 and 6 days respectively.

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الثبات التخزينى وتقييم الجوده لباتيه السمك المنتج من أسماك المبروك العادى وأسماك القراميط

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الملخص العربى

في هذه الدراسة تم تقدير الثبات التخزيني لباتيه السمك المصنع من اسماك القراميط أو اسماك المبروك العادى والمخزنة بالتبريد علي ٤م حيث تم تصنيع باتيه السمك من أسماك القراميط أو المبروك العادى الطازجه و ذلك بفرم الشرائح من كل نوع سمك و تجهيز باتيه السمك من كل منهما باستعمال الاضافات المختلفة و بعد تصنيع باتيه السمك تم تخزينها بالتبريد على ٤°±١ م.

و قد تم اجراء الاختبارات التالية دوريا كل يومين لتقييم الصفات الحسية (لون – رائحة – نكهة – قوام) و الصفات الكيماوية (درجة تركيز ايون الهيدروجين، القواعد النيتروجينيه الكلية المتطايرة و ثلاثي ميثيل الامين و حمض الثيوباربيتيوريك) و الصفات الميكروبيولوجية (العدد الكلي للبكتيريا، البكتيريا المحبة للبرودة، العدد الكلي للفطريات، العدد الكلي للخمائر، بكتيريا القولون وبكتيريا ستافيليو كوكس ايريس).

وقد اظهرت نتائج التقديرات الحسية ومؤشرات الجودة الكيماوية وصفات الجودة الميكروبية ان باتيه السمك المصنع من كلا من القراميط والمبروك اصبح غير صالح للاستهلاك الادمي عند اليوم العاشر والثامن من التخزين بالتبريد علي التوالي.

وقد كان هناك تاثير معنوي للتخزين بالتبريد على التقييم الحسى وقيم درجة تركيز ايون الهيدروجين، القواعد النيتروجينيه الكلية الطيارة وثلاثي ميثيل الامين وحمض الثيوباربتيوريك وكذلك العدد الكلى للبكتريا، البكتيريا المحبة للبرودة ، العدد الكلى للفطريات، و الخمائر. حيث يمكن التوصيه بأن اسماك القراميط والمبروك العادى تعتبر مصادر جيدة لتصنيع باتيه السمك و ذلك لرفع قيمتها التسويقيه.