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THE UTILIZATION OF COMMON CARP *(CYPRINUS CARPIO)* IN THE PRODUCTION OF FISH BURGER, AND CONTROLLING LIPID OXIDATION BY USING SYNTHETIC AND NATURAL ANTIOXIDANTS

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Abstract

Common carp is soft in texture accociated with proteolysis of muscle proteins. It meets many of the criteria desirable for minced fish products. The present work was conducted to throw light on the utilization of common carp in the production of fish burger, as well as, the control of lipid oxidation followed up by using same synthetic and natural antioxidants such as Tenox 27 an Rosemary extract (in a 0.02% concentration as a fat content). Besides, fish burger containing 10% wheat germ was studied. All treated and untreated samples were packaged in polyethylene bags and stored at -20oC for 10 weeks.

The reults obtained declared that, fresh fish burgers at zero time, showed low trimethylamine (TMA) in all treatments, then, increased during frozen storage at -20oC. Results indicated the higher effect of Tenox 27, and Rosemary extract showed an excellet antioxidaant activity similar to the effect of Tenox 27 as the natural antioxidants offering the potential advantages of replacing the syntetic. The sample containing Tenox 27 had lower Thiobarbituric acid (TBA) value at the end of Storage. The colour scores of fish burger decreased with increasing storage period. The untreated samples recorded lower scores han the antioxidant treated ones. Samples containing 10% wheat germ recorded lower scores at all times of the storage period.

INTRODUCTION

The earliest mention of the cultivation of carp in history seems to refer to China. Carp culture became very important in many countries and contributed greatly to the total produuction of fish in the world market (Sarig, 1966). Carp is considered the first growing fish of all Cyprinidae (Bardach *et al.* 1972).

Carp grow well under a variety of cultural conditions, utilize natural foods efficiently, and respond well to supplementary feeding. However, consumers in the industrial countries object to the taste and foning, so, carp are not considered a dinging delicacy (Lovell, 1981).

Common carp (*Cyprinus carpio*) is soft in texture associated with proteolysis of muscle proteins. It meets many colour and flavour profiles and is of low costs. Carp, like any other fish, have to be processed, so that it must be attractive to the consumer. Whole carp fish is not popular, and have a low commercial value for their large size because of the difficulty to fillet and separating their small bones. Processing of carp does offer a product to high quality at a reasonable price.

The specific problems of muddy taste and small bones have been partly solved. The quality of fish is a key factor in the process of production and is now as important as the quatity (Billared and Perchee 1993).

Fish is considered one of the fleshy foods which is rapidly deteriorated towards spoilage in a short period. Deterioration of fish is mainly due to the effect of enzymes from either tissues or contamination with microorganisms producing compounds which lead to off odours, colours and flavour (Hussein *et al.* 1987).

Minced fish technology primarily involves the recovery of flesh from the fish caracass, usually in high yield and in a comminuted form which is large and free from skin and bone (Keay 1983).

Preservation of the nutriment value of fish products depends upon preventing the lilpid oxidation. This can be achieved by adding antioxidants or combination of antioxidants and using low stroage temperature. The discovery of the use of antioxidants to increase the storage life of foods has made possible the marketing of many new products, and has directly benefited the pocket books of consumers. To day anxtioxidants are widely used in processed foods.

In Egypt, very limited informations are reported concerning the effect of using antioxidants on preservation and increasing the keeping quality of fish burger during storage under low temparture for conservation.

Consequently, the purpose of this study is to utilize common carp (*Cyprinus carpio*) in the production of fish burger, as well as, studying the effect of treating it with antioxidants to extend the shelf-life of fish burgers during freezing and frozen storage at -20°C for 10 weeks. The changes in the frozen state were followed by chemical, physical and sensory evaluation.

MATERIALS AND METHODS

Fresh common carp fish was obtained from Central Laboratory for Aquaculture Reseach, Abassa, Abou-Hammad, Sharkia. On receipt at the Lab., the

fish was immediatley washed and weighed thoroughly with tap water.

The fish were killed by a blow to the head, then, bleeding 15 minuts and washed in clean cold water to remove the slime and related spiolage bacteria from the surface of the fish. In addition, any dirt and debris, after removal of non-edible parts scales, head, tail, skin, and viscera, the body cavity was washed, and then, the fish muscles were separated from the bones, and weights were recorded to the nearest gramme. Dressing percentage was determined according to Lovell (1981) by using the following frormula:

$$\text{Dressing \% (Flesh \%)} = \frac{\text{weight of fish fles}}{\text{weight of the hole fish}} \times 100$$

The fillets were minced using meat mincer Baun for 30 seconds at maximum speed. The minced fish flesh was kept uunder cooling (less than 5^{o}C.)

About 21 Kg. of minced fish muscle was divided into three equal batches each of which was then formed using different ingredients as shown in Table 1.

Table 1. Ingredients used in fish burgers Formulation.

Treatment	Ingredients
Control	Minced fish +2% salt+2% Spices.
Treatment 1.	Control + 0.02% antioxidant Tenox 27 of the fat content
Treatment 2.	Control + 0.02% antioxidant Rosemary extrate of the fat content.
Treatment 3.	Control + 10% (w/w) wheat germ as antioxidant.

Tenox 27: Synthetic antioxidant consisting of propylene glycol 34%, Butylated hydroxyanisol (BHA) 28%, Glyceryl monooleate 20%, Tert-Butylhydro quinone (TBHG) 12% and Citric acid 6%).

Rosemary extract and when germ are natural antioxidants. The ingredients of each treatment were chemically shaped into fish burgers, packed in polyethylene bags, frozen and stored at - 20^{o}C±2^{o}C.

Analytical determinations

Chemical Different samples of fish burgers were periodically analyzed every two weeks during the frozen storage period of 10 weeks. Moisture, total protein, total

lipid and ash were determined as described by the A.O.A.C. 1990. Total volatile nitrogen bases (TVNB) were measured according to the method described by Sinnhuber *et al* (1966). Trimethylamine (TMA) was estimated according to the method reported by Dyer (1959). Free amino nitrogen (FAN) was applied as described in A.O.A.C. (1990). The procedure by Tarladgis *et al.* (1960) was used to determine thiobarbituric acid (TAB). The cooking loss of fish burgers was calculated by difference (weight of samples before and after frying).

Sensory evaluation

The organolepic properties of the prepared fish burgers after deep oil frying, were judged by a panel of 15 members from The Central Laboratory For Aquaculture (CLAR) Research, Abbassa, Abou-Hammad, Sharkia, who were asked to give a score out of ten point hedonic hedonic scale.

RESULTS AND DISCUSSION

1. Yields of common carp fish after filleting Process

Table 2 represents the yield percentage of different sizes of common carp fish after filleting process. The data indicated that, large size of common carp fish yielded higher percentage of flesh and lower percentage of non-edible parts in comparison with small size of fish. These results are in parallel with Hussein (1990) who found inverse relation between flesh and non-edible parts (N.E.P.) percentages of common carp inversely proportional to the whole fish weight.

Table 2. Relation between flesh and non-edible parts (N.E.P.) % of common carp fish.

No.	Total weight	Flesh		N.E.P.	
	(g.)	(g.)	%	(g.)	%
1	252	118.11	46.92	133.89	53.13
2	364	183.79	53.12	162.21	46.88
3	535	304.62	56.92	230.38	43.06
4	764	443.81	58.09	320.19	41.91
5	875	524.60	59.95	350.19	40.05
6	1121	683.22	60.95	437.78	39.05
7	2742	2012.18	73.38	729.82	26.26
8	3764	2987.3	79.36	776.97	20.64

2. Chemical changes

Table 3 represents the chemical compostion and the quality attributes of control treatment of common carp fish used as a raw material for fabrication of burgers.

Table 3. Chemical composition and quality attributes of control fresh treatment of fish burger.

Constituents	%
Chemical composition	on dry weight bases
Moisture	74.69
Crude Protein	78.70
Crude fat	12.41
Ash	7.60
Chemical quality attributes: on wet weight bases	
Total volatile nitrogen bases (TVNB) (mg/100g)	1.42
Trimethylamine (TMA) (mg/100 g.)	0.32
Free amino nitrogen (FAN) (mg./100g.)	1.25
Thiobarbituric acid (TBA)	0.043

The chemical composition of control treatments are shown in Table 3 from which, it could be noticed that its lipid content exceeds 10% on dry wt. bases. The chemical attributes, namely (TVNB), TMA, FAN, and TBA indicated the high freshness of the raw material used for preparation of fish burgers.

Changes in total volatile nitrogen bases (TVNB) and trimethylamine (TMA):

TVNB is a mixture of many volatile nitrogenous compound, such as amonia and other lower simple mono amines. It is usually used as an index of freshness of protein materials of fish (Hammad 1985). The obtained result presented in Table 4 indicate that the TVNB increased with prolonging frozen storage in all treatments of fish burgers. However, this depends on the types of material added in the prepared formulas.

The same results (Table 4) revealed that, the TVNB in control formula increased considerably compared with other different formulas during frozen storage at-20oC for 10 weeks on wet weight bases.

Table 4. Changes in the TVNB of fish burgers during frozen storage at -20oC for 10 weeks

Treatments	Storage period of weeks					
	0	2	4	6	8	10
Control	1.42	2.60	2.96	3.56	3.95	4.64
tr.1	1.43	2.58	2.80	3.32	3.52	3.78
tr.2	1.43	2.57	2.84	3.46	3.68	3.95
tr.3	1.34	2.54	2.77	3.32	3.53	3.68

tr.1 = treatment 1, tr.2 = treatment2, and tr.3 = treatment 3

During frozen storage, TVNB content showed slight increase in antioxidant treatments which indicated that the frozen storage and the presence of antioxidants led to reduction of bacterial decomposition. Meanwhile, at the end of the storage period, the treatment contaning 10% wheat germ showed the lower amount of TVNB which night be due to decreased moisture which indicated the highest effect in reducing bacterial and enzymatic decomposition.

On the other hand, the TMA content was also used as an index of fish and products quality.

The results given in Table 5 indicated that, fish burgers at zero time had low TMA in all treatments on dry weight bases, after which they increased during frozen storage. The production of TMA during frozen storage might be attributed to the breakdown of protein by the effect of bacterial decomposition and enzymes (Bonnell 1994).

Table 5. Changes in the TMA of fish burgers during frozen storage at -20oC for 10 weeks

Treatments	Storage period of weeks					
	0	2	4	6	8	10
Control	0.32	0.69	0.75	1.02	1.23	1.31
tr.1	0.33	0.57	0.67	0.87	0.93	0.96
tr.2	0.33	0.60	0.71	0.94	1.02	1.06
tr.3	0.31	0.64	0.70	0.92	0.98	1.01

tr.1 = treatment 1, tr.2 = treatment2, and tr.3 = treatment 3

The control samples reached up to the hightest amount of TMA (1.31 mg/100 gm. on wet weight bases) at the end of frozen storage period. Meanwhile, the treatment No.3 containing 10% wheat germ had the least amount of TMA (1.01 mg/100 gm.) at the end of storge period. This result might be attributed to the low level of moisture in the formula No.3 which caused lower chemical changes such as TMA. TVNB and TBA during forzen storage.

According to antioxidant treatment, forzen storage reduced markedly the formulation of TMA reflecting the greater effect of Tenox 27 on total bacterial count.

Changes in Free amino nitrogen (FAN) 2

Data given in Table 6 show the changes in FAN due to treatments (With and without anxtioidants) during frozen storage at-20°C for 10 weeks. Also, results indicated an increase in FAN throughout storage period.

Table 6. Changes of FAN in fish burgers during storage at-20°C.

Treatments	Storage period of weeks					
	0	2	4	6	8	10
Control	1.25	1.43	1.57	1.63	1.71	1.82
tr.1	1.25	1.29	1.34	1.46	1.56	1.63
tr.2	1.34	1.38	1.52	1.60	1.67	1.72
tr.3	1.29	1.42	1.59	1.64	1.72	1.79

tr.1 = treatment 1, tr.2 = treatment2, and tr.3 = treatment 3

It could be also observed that tr.1 containing Tenox 27 recorded the lowest free amino nitrogen more than the other treaments, while, treatment 3, containing wheat germ showed the highest content of FAN.

Free amino nitrogen was used to follow the protein degredation by bacterial and/or autoltic enzymes present in the tissues. The results presented in Table 6 show that all treatments were under gradual protein degredationduring frozen storage at 20oC. The range of degredation was less in tr.1 than in all other treatments.

Changes in thiobarbituric acid (TBA) in fish burgers during frozen storage at 20°C.

The thiobarbituric acid value was used as an index for the lipid oxidation taking place in fish burgers during frozen storage.

The resultes in Table 7 revealed that, the TBA value of fish burgers tended to increase gradually during frozen storage. This increase in the TBA value could be due to autooxidatio of fish lipids and the formation of some TBA reacting substances during frozen storage (Etman 1985 and Bonnell 1994).

Table 7. Changes of thiobarbituric acid in fish burgers during storage at -20oC.

Treatments	Storage period of weeks					
	0	2	4	6	8	10
Control	0.043	0.080	0.095	0.143	0.184	0.211
tr.1	0.043	0.051	0.069	0.078	0.084	0.091
tr.2	0.043	0.070	0.081	0.185	0.152	0.166
tr.3	0.043	0.069	0.0139	0.139	0.167	0.181

tr. = treatment

The results indicated that, control treatment showed the highest increase of TBA value more than other treatments during frozen storage.

Regarding the treatment containing Tenox 27, results indicated a lower TBA value (0.091) followed, by treatment containin Rosemary extract which was 0.166 when compared with other treatments at the end of frozen storage period.

Sensory evaluation of fish burgers

The mean tastes panel scores for colour, flavour and texture of the investigated fish burgers are summarized in Tables 8, 9.

Table 8. Mean sensory scores for fish burgers formulation during frozen storage at-20^{o}C for 10 weks.

Treatments	Storage period of weeks Storage period of weeks											
	0	2	4	6	8	10	0	2	4	6	8	10
Control	8.00	7.75	7.62	7.59	7.56	7.54	9.00	8.40	8.36	8.27	8.18	7.89
tr.1	7.82	7.80	7.73	7.68	7.67	7.64	8.80	8.76	8.74	8.71	8.67	8.62
tr.2	7.80	7.72	7.65	7.60	7.58	7.58	8.83	8.78	8.75	8.73	8.66	8.60
tr.3	7.00	6.85	6.45	6.42	6.41	6.39	8.60	8.54	8.52	8.49	8.42	8.39

tr.1 = treatment 1, tr.2 = treatment2, and tr.3 = treatment 3

The colour plays a major role in the acceptance of fish burgers. The deterioration in colour may be due to lipid oxidation as reported by Jones (1962), and/or to changes in pigment proteins, as mentioned by Shenouda (1980).

The washing process of fish flesh produces lighter colour because washing removes heme and nonheme as reported by Rhee *et al.* (1987) and Hoke (1993).

The scores indicated that replacing wheat germ by 10% of minced fish in treatment No.3 lead to decrease color scores. The color scores decreased graduallay as the frozen storage increased.

The variation in colour of fish burgers could be attributed to the effect of different additives used, whereas, the variation in colour during frozen storage may be due to the effect of freez temprature resulting in changes in the quality of fish burgers and delerioration in colour.

The Treatment No.3 containing wheat germ had lower colour scores at any given time of storage.

The flavour is probably the most important attribute that influence the organoleptic properties of fish and fish products.

Table 8 shows the effect of using additives and storage time at -20°C for 10 weeks on the flavor of investigated treatments. The undesirable changes in flavour may be due to the formation of some compounds from lipid oxidation or protein deterioration. These results agree with those reported by Shenouda (1980).

At zero time, the control treatment that had flavour score (8.00) and other treatments with additives had lower scores indicating that the additives had affected the flavour of fresh fish burgers. Fish flavour decreased when frozen storage increased. Antioxidants may be used for controlling oxidized flavour from oxidative rancidity Sweet (1973). Also, frozen storage and packing in polyethylenc bags retarded oxidative deterioration which caused off-flavour. On the other hand, wheat germ resulted in decreasing flavour ratings during frozen storage more than other antioxidant treatments, but showed flavour scores higher than control treatment.

Data given in Table 9 show the texture scores of fish burgers treatments with and without antioxidants during frozen storage at-20oC for 10 weeks. The data indicated undesirable changes in the texture of fish burger treatments which may be due to protein denaturation and decrease in moisture content through frozen storage at-

20°C. These results are in a close agreement with those reported by Sikorski (1980) and Eun *et al.* (1994).

Table 9. Mean texture scores for fish burgers formulation during frozen storage at -20 for 10 weeks.

Treatments	Storage period of weeks					
	0	2	4	6	8	10
Control	7.90	7.58	7.30	7.24	7.17	7.12
tr.1	7.80	7.77	7.71	7.69	7.68	7.64
tr.2	7.83	7.75	7.63	7.58	7.55	7.53
tr.3	7.20	7.10	6.96	6.92	6.90	6.87

tr.1 = treatment 1, tr.2 = treatment2, and tr.3 = treatment 3

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إستخدام سمك المبروك العادى فى إنتاج برجر السمك والتحكم فى أكسدة الدهن باستخدام مضادات الأكسدة الطبيعية والصناعية

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هذا العمل متعلق بالقاء الضوء على استخدام سمك المبروك العادى فى انتاج برجر السمك بالاضافة الى التحكم فى أكسدة الدهن بأستخدام مضادات الأكسدة الصناعية والطبيعية مثل تونكس - ٢٧ ومستخلص حصى البان بتركيز ٠,٢ ٪ بالنسبة لمحتوى الدهن ، بجانب دراسة برجر السمك المحتوى على ١٠٪ جنين القمح. وضعت جميع العينات المعاملة والغير معاملة فى عبوات بولى ايثيلين وحمبدت وخزنت على درجة - ٢٠ ه م لمدة ١٠ اسابيع .

اوضحت النتائج المتحصل عليها بالنسبة لبرجر السمك الطازج عند بداية التخزين انخفاض فى ثلاثى ميثيل الأمين فى جميع العينات ثم زيادته خلال التخزين على -٢٠ه م.

وتشير النتائج الى زيادة التأثير لتونكس - ٢٧ ، وأظهر مستخلص حصى البان تأثير ممتاز كمضاد للاكسدة مشابه لتونكس - ٢٧ وبذلك يمكن إحلال مضادات الأكسدة الطبيعية محل الأكسدة الصناعية. كما أن قيمة حمض الثيوباربتيوريك تكون منخفضة فى العينة المحتوية على تونكس - ٢٧ حتى نهاية التخزين وتقل درجات تقييم اللون لبرجر السمك بزيادة مدة التخزين، وتظهر العينات الغير معاملة إنخفاضا فى درجات التقييم طوال مدة التخزين.