Assessment of nutritional value and sensory quality of salted roes of catfish *Clarias gariepinus*

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ABSTRACT

Some chemical, bacteriological and organoleptical changes of fresh roes (Batarekh) catfish *Clarias gariepinus* soaked in salt solution was prepared from sodium chloride 12.0% (w/w), 3.5% vinegar (6% conc.), 0.1% ascorbic acid and 1.5% spices. Besides 7, 14 and 21 p. p. m Nisin for 12-15 hours. After that, all treatment samples kept at room temperature for 30 days. During the storage period, chemical indices of freshness, fatty acides, bacterial count and sensory evaluation showed increasing trends, they were considerably lower in the samples soaked in salt solution + 21 p. p. m Nisin compared with other samples.

Keywords: sensory quality, salted roes, *Clarias gariepinus*

INTRODUCTION

Roe contains high amounts of protein and lipid because of its physiological role as a reserve. Fish roes appreciated not only for good quality protein, but also for the fat which sometimes may reach 20%, have much alpha-tocopherol (the natural antioxidant), and showing about 50% unsaturated fatty acids. Pasteurization was found to retard the lipid hydrolysis of roes (Kaitaranta, 1982; Syvacoja *et al.,* 1985 and Wu *et al.,* 1987).

Salting and drying is the most common method of fish preservation. In many developing countries dried salted fish is an important source of low-cost dietary protein. Salting techniques are simple and involve salt crystals or brine. There are three types of salting of fish: dry salting, wet salting and a combination of the two methods. Length of salting period as well as salt concentration depends on the expected final product. However, salting technique, brine concentration and salting period have a direct effect on drying kinetics and characteristics of final product (water content, salt content, texture, etc.) Traditionally, sun drying is widely used for drying fish. This technique is directly related to weather conditions and thus makes the results uncertain. The main problems attributed to dried salted fish are the variable but often low quality final product, its high salt content, insect infestation and microbial contamination which induce a rapid rate of deterioration during transport, distribution and storage. Barat *et al*. (2002).

Martı´nez-Alvarez *et al*. (2005) declared that salting is one of the oldest techniques known to man for the conservation of fish. Salting is essentially intended to prolong the shelf life of the product by reducing its water activity. This is traditionally done by placing fish fillets or boned fish in book-fashion in layers with salt in between. The process can be a long one (1-8 weeks), in which the position of the fish is altered every so often to ensure uniform salting.

According to Kim and Hearnsberger (1994) using *Pediococcus acidilactici* to manufacture fish sausage could accelerate the formation of lactic acid and significantly inhibit the growth of spoilage bacteria and pathogens, which consequently extended the shelf life and also enhanced the safety. Rapid decline of

pH not only gives the products a unique lactic acid flavor, but also increases the texture firmness and mouth feel due to the acid denaturation of muscle proteins.

Gelman *et al*. (2000) found that some fermented meats or fish are very popular in oriental countries and also in parts of western countries. In recent years, using pure bacterial cultures to produce a fish type product is attracting increasing interest. Various researchers have stated that using lactic acid bacteria (LAB) in fish meat has improved the quality of the end product.

Wirth *et al*. (2000) demonstrated that average protein content varied between 26.2 and 31.1% (wet wt.) and fat content from 10.9 to 19.4% with lowest values for caviar from farmed sturgeon. The same authors reported that Cu and Zn concentration of caviar from sturgeon varied between 1.20 - 1.69 and 10.3-12.4 mg/kg, respectively. These values reflect the elevated requirement of sturgeons for these components. Also, Pb content varied between 0.06 and 0.15 mg/kg and Cd concentration were <5 µg/kg leading to conclusion that no accumulation took place in the eggs.

Paludan-Muller *et al.* (2002) reported that the development of new fish products, which would be free of the fishy odor and taste, and which retained all the nutritional advantages of fish, would enlarge the range of applications of silver carp muscle. A promising approach to the creation of such fish products seems to be through the use of fermentation. The fermentation of fish for human consumption has many benefits.

Manat, *et al.* (2006) noticed that the fresh fish is susceptible to spoilage caused by both microbiological and chemical reactions. Lipid deterioration easily takes place and limits the shelf-life of oily fish during storage. Both hydrolytic and oxidative rancidities in fish muscle are associated with quality deterioration. Hydrolysis, induced by lipases and phosphor lipases, produces free fatty acids that undergo further oxidation to produce low-molecular weight compounds that are responsible for the rancid off-flavour and taste of fish and fish products.

Hu *et al*. (2008) Lactic acid fermentation is an important method of preserving perishable fish and marine products in developing countries. Lactic acid bacteria (LAB) could cause rapid acidification of the raw material, through the production of organic acids, mainly lactic acid and acetic acid, and also produce a variety of antimicrobial substances, which can consequently prevent the growth of most hazardous food microorganisms.

Yanshun *et al*. (2010). Higher temperature stimulated the rapid growth of lactic acid bacteria, resulting in a rapid decline in pH, and consequently suppressed the growth of *Pseudomonas, Micrococcaceae* and *Enterobacteriaceae*. However, increasing fermentation temperature gave a progressive increase in total volatile basic nitrogen and biogenic amines in fermented silver carp sausages. Higher content of non-protein nitrogen and a-amino nitrogen correlated with the electrophoretic studies, which showed that proteolysis of high molecular weight myofibrillar and sarcoplasmic proteins was more prominent at higher fermentation temperatures.

The objective of the study is aimed at investigating fast fermentation technology for salt fresh roes (Batarekh), in which catfish *Clarias gariepinus* were used as material. The changes on biochemical, microbial and organoleptic quality were compared in different salt fresh roes catfish fermentation technology process.

MATERIALS AND METHODS

Sampling:

Fresh roes removed from ovaries of catfish *Clarias gariepinus* obtained from Aquaculture Abbassa-Abou-Hammad-Sharkia immediately after catching and

transported to the laboratory. The roes were cleaned, washed with tap water and soaked for 12 -15 hours at 5ºC±1 in salt solution. A stock of salt solution was prepared from sodium chloride 12.0% (w/w), 3.5% vinegar (6% conc.), 0.1% ascorbic acid and 1.5% spices mixture consists of 22.5% coriander, 7.5% cubeb, 15.0% cummin, 30.0% black pepper, 10.0% red pepper, 10.0% cardamon and 5.0% cloves. After salting process, washing samples with tap water to remove the excess salt for 5 min. The roes were divided into the following four treatment trials:

1- roes soaked for 12 -15 hr. at 5ºC±1 in salt solution.
2- roes soaked for 12 -15 hr. at 5ºC±1 in salt solution + 7 p.p.m nisin.
3- roes soaked for 12 -15 hr. at 5ºC±1 in salt solution +14 p.p.m nisin.
4- roes soaked for 12 -15 hr. at 5ºC±1 in salt solution + 21 p.p.m nisin.

Nisin solution preparation:

A stock of nisin was prepared from a commercial preparation containing (7, 14 and 21 p.p.m) nisin .The commercial preparation was dissolved in salt solution preparation using HCl 0.02 N to pH 2- 4 in which the nisin will be dissolved, Kelley *et al*. (1999). The pH of a stock nisin solution was adjusted to pH 4 using pH-meter (Orion Research Digital Ion analyzer, Model 420A.).

Thereafter, the roes were left in the room temperature for two days in order to be fermented. All treated samples were stored in room temperature at 25±5ºC for 30 days. At the end of 0, 5, 10, 15, 20, 25 and 30 days, samples were randomly withdrawn for analysis.

Analytical procedures:

Thiobarbituric acid value (TBA) was estimated as described by Tarlagis *et al.* (1960). Total volatile bases nitrogen (TVBN), and Trimethylamine nitrogen (TMAN) were determined according to the method recommended by the AMC (1979). Total bacterial count (TBC) was determined according to the method described by Swanson *et al.* (1992). Halophilic bacterial count (HBC) was determined according to the method mentioned by Baross and Lenovich (1992).

Fatty acids:

Fatty acids were analyzed as described by Jeong *et al.* (2000). Fatty acid methyl ester (FAME) was derived by methylation with 14% BF_3 in methanol. The FAME composition of total lipids (TL) was analyzed using a gas-liquid chromatograph (Shimadzu GC14A; Shimadzu Seisakusho, Co. Ltd., Kyoto, Japan) equipped with an Omegawax 320 fused silica capillary column (30m x 0.32 mm, ID; Supelco, Bellefonte, PA, USA). Injection port and a flame-ionization detector were held at 250ºC, and the column oven temperature was initially held at 180ºC for 8 min and then programmed to a final temp. of 230ºC at 3ºC/min. Helium was used as a carrier gas at the constant column inlet pressure of 1.0 kg/cm^2 with a split ratio of 1:50. Peak assignments were carried out by comparison of retention times of authentic standards (Sigma Chemical Co., St Louis, MO, USA) as well as oyster fatty acids which had been analyzed. Methyl tricosanoate (99%; Aldrich Chem. Co., Milwaukee, WI, USA) was used as an internal standard. This procedure was carried at the Central Laboratory, Faculty of Agriculture, Ain Shams University**.**

Organoleptic evaluation:

Samples were organoleptically evaluated for color, flavor and texture. A group of 10 staff members of technology and quality control department, control laboratory for Aquaculture research abbassa abouhammad sharkia as judges were always called upon for scoring the organoleptic properties of the samples by given grads ranging from zero to 10 according according to Teeny and Miyauchi (1972) as estimated by the following scheme:

Score	Description	Score	Description
10	Ideal	4	Fair
9	Excellent	3	Poorly fair
8	Very good	2	Poor
7	Good	1	Very poor
6	Fairly good	0	Repulsive
5	Acceptable		

Statistical analysis:

Three replicates of each trial were performed for analysis. Moisture, protein, total lipids, ash, carbohydrates and sensory data were statistically analyzed using ANOVA and means were separated by Duncan' test at a probability level of $P<0.05$ (SAS, 2000).

RESULTS AND DISCUSSION

Results presented in Table (1) indicated a gradual increase in thiobarbituric acid (TBA) value of fresh roes removed from ovaries of catfish *Clarias gariepinus* up to 30 days of storage. Minimum of TBA was found in roes soaked for 12 -15 hr. at 5ºC±1 in salt solution + 21 p.p.m nisin. On the other hand, samples untreated with nisin recorded 4.40mg/Kg.

Table 1: Changes in thiobarbituric acid values (TBA) (mg. malonldehyde / Kg.) of salted roes treated with different concentrations of nisin during storage period at room temperature.

Treatment		Control	Salt with 7 p.p.m nisin	Salt with 14 p.p.m nisin	Salt with 21 p.p.m nisin
Storage period (days)	**0**	0.30± 0.01 ^{a}	0.30± 0.01 ^{a}	0.30±0.01^{a}	0.30±0.01^{a}
	5	1.18± 0.01 ^{a}	0.85±0.02^{ab}	0.68±0.02^{b}	55±0.01^{bc}.0
	10	2.00± 0.01 ^{a}	1.60±0.01 ^{b}	1.23±0.02^{bc}	0.85±0.02^{c}
	15	2.55± 0.02 ^{a}	2.10±0.02 ^{b}	1.90±0.02^{bc}	1.20±0.02^{d}
	20	3.20± 0.02 ^{a}	2.70±0.03 ^{b}	2.57±0.02^{bc}	1.60±0.01^{c}
	25	3.85± 0.03 ^{a}	3.30±0.02 ^{b}	3.27±0.02^{bc}	1.95±0.02^{c}
	30	4.40± 0.03 ^{a}	4.05±0.03 ^{b}	3.90±0.02^{c}	2.27±0.02^{d}

$^{a-d}$ Means within a column with the same superscript significantly different ($P<0.05$).

Values are expressed as Mean ± SE.

The increment in TBA presumably resulted from the concentration of pigmets fish fillets which can act as a proxidant. From the other side, there were insignificant difference ($P< 0.05$) in TBA value between the samples salted with different concentrations of nisin during storage at room temperature for 30 days. Bonnell (1994) showed that, fish and fish products of good quality will have TBA-value less than 2 while poorer quality fish will have a TBA-value within 3 and 27. Fish with TBA greater than 2 will probably smell and taste rancid. These results are in agreement with those reported by Khuntia *et al.* (1993).

Total volatile bases nitrogen and trimethylamine nitrogen:

Results presented in Tables (2 and 3) indicate that the formation of total volatile bases nitrogen TVBN and trimethylamine nitrogen TMAN (mg./100g) were affected by all treatments. Throughout storage a gradual increase in TVBN and TMAN occurred and were 4.48 and 1.46 (mg/100g) at zero time, respectively, then reached to 79.00, 66.34, 49.02 and 31.89 (mg/100g) for TVBN, and 47.00, 30.00, 23.50 and 16.50 (mg/100g) for TMAN for roes soaked in salt solution +.4, 14 and 21 p.p.m nisin for 12 -15 hr. at 5ºC±1 respectively.

Table 2: Changes in Trimethylamine nitrogen (TMAN) (mg./100g.) of salted roes treated with different concentration of nisin during storage period at room temperature.

Treatment		Control	Salt with 7 p.p.m nisin	Salt with 14 p.p.m nisin	Salt with 21 p.p.m nisin
Storage period (days)	**0**	1.46±0.02[a]	1.46±0.02[a]	1.46±0.03[a]	1.46±0.03[a]
	5	8.37±2.04[a]	5.59±0.04[b]	4.76±0.03[c]	3.80±0.03[d]
	10	16.20±0.15[a]	10.48±0.11[b]	8.52±0.10[c]	4.97±0.12[d]
	15	23.57±0.17[a]	16.17±0.15[b]	12.20±0.14[c]	7.81±0.11[d]
	20	30.82±0.20[a]	20.30±0.22[b]	16.13±0.25[c]	10.32±0.24[d]
	25	38.19±0.33[a]	25.21±0.31[b]	19.80±0.29[c]	12.91±0.25[d]
	30	47.00±0.51[a]	30.00±0.45[b]	23.50±0.43[c]	16.05±0.41[d]

[a-d] Means within a column with the same superscript significantly different (P<0.05).
Values are expressed as Mean ± SE.

Table 3: Changes in Total volatile basic nitrogen (TVBN) (mg./100g.) of salted roes treated with different concentration of nisin during storage period at room temperature.

Treatment		Control	Salt with 7 p.p.m nisin	Salt with 14 p.p.m nisin	Salt with 21 p.p.m nisin
Storage period (days)	**0**	4.48±0.05[a]	4.48±0.06 [a]	4.48±0.05[a]	4.48±0.05[a]
	5	19.65±0.25 [a]	14.62±0.23[b]	11.80±0.22[c]	8.89±0.20[a]
	10	37.02±0.28 [a]	25.37±0.27[b]	19.00±0.25[c]	13.36±0.21[d]
	15	48.62±0.33 [a]	35.41±0.32[b]	25.09±0.29[c]	18.01±0.27[d]
	20	59.00±0.38 [a]	54.00±0.35[b]	33.78±0.31[c]	23.00±0.30[d]
	25	70.57±0.44 [a]	55.19±0.42[b]	40.10±0.41[c]	27.90±0.39[d]
	30	79.00±0.59 [a]	66.34±0.55[b]	49.02±0.52[c]	31.89±0.50[d]

[a-d] Means within a column with the same superscript significantly different (P<0.05).
Values are expressed as Mean ± SE**.**

From the other side, there was insignificant difference (P< 0.05) in TVBN and TMAN values between the samples salted with different concentrations of nisin during storage at room temperature for 30 days. The lowest values TVBN and TMAN occurred in roes samples soaked in salt solution + 21 p.p.m nisin for 12 -15 hr. at 5ºC±1 while maximum TVBN and TMAN were found in control roes samples soaked in salt solution for 12 -15 hr. at 5ºC±1. Connel (1990) reported that the content of TVBN is a useful indicator of freshness of lean fish and suggested 30-40mg N/100g (on fresh weight basis) as the upper limit for fresh – water fish and marine fish, respectively. Also Maga (1978) reported that perfectly fresh fish had 3.37mg/100g of TMAN, good grade fish showed 3.79-5.90mg/100g, fair fish had 12.65-16.02mg/100g while spoiled fish contained as high as 59.01mg/100g. However, the increment in TVBN and TMAN during storage could be the result of decomposition and degradation of nitrogen substance which may be due to the activity of microorganisms. These results are in line with those obtained by Woyewoda & Bligh (1986) and Khuntia *et al.* (1993).

Fatty acids composition:

The results in Tables (4) showed saturated fatty acids composition (%) for roes of catfish *Clarias gariepinus* soaked in salt solution + 7, 14 and 21 p.p.m nisin for 12 -15 hr. at 5ºC±1. It is evident that control roes had 24.3% saturated fatty acids, while in other treatments there were 28.1, 25.2 and 25.3% for treatments soaked in salt solution + 7, 14 and 21 p.p.m nisin respectively. Monounsaturated fatty acids composition (%) were 50.4%, 42.0, 59.4 and 59.4%, Polyunsaturated fatty acids composition (%) were 0.7%, 0.9, 0.4 and 0.3% and Eicosatrienoic fatty acids composition (%) were 1.8%, 0.0, 1.7 and 1.4% at the beginning of storage period at room temperature

Table 4: Fatty acids composition (%) of roes catfish *Clarias gariepinus* soaked in salt solution + 7, 14 and 21 p.p.m nisin for 12 -15 hr. at 5ºC±1 at 0 day and the end of storage period for 30 days at room temperature.

Fatty acids		Control	Salt with 7 p.p.m nisin	Salt with 7 p.p.m nisin	Salt with 14 p.p.m nisin	Salt with 14 p.p.m nisin	Salt with 21 p.p.m nisin	Salt with 21 p.p.m nisin
			0 day	30 day	0 day	30 day	0 day	30 day
Saturated								
Miristic	**14:0**	1.2	1.1	1.3	1.2	1.3	1.1	1.1
Palmitic	**16:0**	18.2	19.7	21.0	18.3	18.7	18.8	18.8
Heptadecanoic	**17:0**	0.9	1.5	0.6	0.7	0.7	0.6	0.6
Stearic	**18:0**	3.4	5.1	3.5	4.1	4.8	4.1	4.1
Behenic	**22:0**	0.6	0.7	0.3	0.9	1.0	0.7	0.7
∑		24.3	28.1	26.7	25.2	26.5	25.3	25.3
Monounsaturated								
Palmitoleic	**16:1**	9.2	7.4	11.1	10.1	8.6	9.8	9.8
Oleic	**18:1 9c**	36.7	30.2	41.2	44.8	43.6	44.0	44.0
Vacenic	**18:1 7c**	4.5	4.4	5.4	4.5	4.5	5.6	5.6
∑		50.4	42.0	57.7	59.4	56.7	59.4	59.4
Polyunsaturated								
Linoleic	**18:2 ω6**	17.4	15.7	10.1	8.8	8.2	9.4	9.4
c-Linolenic	**18:3 ω6**	0.4	1.1	0.2	0.2	0.2	0.2	0.2
a-Linolenic	**18:3 ω3**	0.0	0.7	0.6	0.6	0.5	0.6	0.6
cis-11,14 Eicosadienoic	**20:2**	0.9	1.5	0.6	0.7	0.7	0.6	0.6
cis-8,11,14	**20:3**	0.7	0.9	0.40	0.4	0.5	0.3	0.3
Eicosatrienoic								
Arachidonic	**20:4 ω6**	3.3	0.7	1.3	2.1	3.0	1.8	1.8
EPA	**20:5 ω3**	0.4	0.06	0.2	0.3	0.2	0.3	0.3
DHA	**22:6 ω3**	0.9	3.5	0.4	1.2	1.3	1.0	1.0
∑		24.0	31.0	14.6	14.3	14.2	14.6	16.7
Not identified		1.8	0.0	1.8	1.7	2.2	1.4	1.1

On the other hand, at the end of storage period for 30 days at room temperature the saturated fatty acids composition (%) for roes of catfish *Clarias gariepinus* soaked in salt solution + 7, 14 and 21 p.p.m nisin for 12 -15 hr. at 5ºC±1. It is evident that control roes had 25.2% saturated fatty acids, while in other treatments there were 26.7, 26.5 and 25.3% for treatment soaked in salt solution+7,14 and 21 p.p.m nisin respectively. Monounsaturated fatty acids composition (%) were 59.4%, 57.7, 56.7 and 59.4%, Polyunsaturated fatty acids composition (%) were 0.4%, 0.4, 0.5 and 0.3% and Eicosatrienoic fatty acids composition (%) were 1.1%, 1.8, 2.2 and 1.1%. At the end of storage period for 30 days at room temperature. These results are in harmony with those obtained by Wu and Lillard (1998); Cengarle *et al*. (2000) and Jeong *et al*. (2000).

Total bacterial count changes:

Results presented in Tables (5 and 6) indicate that maximum of total bacterial count (TBC) and halophilic bacterial count (HBC) were affected by all treatments. Throughout storage, a gradual increase in TBC and HBC occurred and were 3.21 and 2.11 Log_{10} CFU/g at zero time, respectively, then reached to 10.30, 8.62, 7.40 and 5.61 Log_{10} CFU/g for TBC, and 5.23, 4.49, 4.19 and 3.83 Log_{10} CFU/g for HBC for roes soaked in salt solution + 7, 14 and 21 p.p.m nisin for 12 -15 hr. at 5ºC±1 respectively. From the other side, there were insignificant different ($P< 0.05$) in TBC and HBC Log_{10} CFU/g between the samples salted with different concentrations of nisin during storage at room temperature for 30 days. These results coincide with those given by Mendonca *et al*. (1989); Khuntia *et al.* (1993); Kim *et al.* (1995); Zhuang *et al*. (1996) and Marshal and Jindal (1997).

Table 5: Changes in Total bacterial count (Log10 CFU/g) of salted roes treated with different concentration of nisin during storage period at room temperature.

Treatment		Control	Salt with 7 p.p.m nisin	Salt with 14 p.p.m nisin	Salt with 21 p.p.m nisin
Storage period (days)	**0**	3.21±0.06[a]	3.21±0.06[a]	3.21±0.05[a]	3.21±0.05[a]
	5	4.35±0.08[a]	4.00±0.07[b]	3.74±0.07[c]	3.50±0.06[d]
	10	5.51±0.07[a]	4.95±0.08[b]	4.29±0.06[c]	3.82±0.05[d]
	15	6.62±0.11[a]	5.91±0.10[b]	5.00±0.09[c]	4.18±0.08[d]
	20	7.80±0.15[a]	6.85±0.13[b]	5.81±0.12[c]	4.56±0.13[d]
	25	8.96±0.18[a]	7.75±0.18[b]	6.61±0.17[c]	4.99±0.15[d]
	30	10.30±0.22[a]	8.62±0.21[b]	7.40±0.21[c]	5.61±0.18[d]

[a-d] Means within a column with the same superscript significantly different (P<0.05).

Values are expressed as Mean ± SE**.**

Table 6: Changes in Halophilic bacterial count (Log10 CFU/g) of salted roes treated with different concentration of nisin during storage period at room temperature.

Treatment		Control	Salt with 7 p.p.m nisin	Salt with 14 p.p.m nisin	Salt with 21 p.p.m nisin
Storage period (days)	**0**	2.11±0.03[a]	2.1±0.03[a]	2.11±0.03[a]	2.11±0.02[a]
	5	2.58±0.06[a]	2.47±0.05[b]	2.41±0.05[bc]	2.35±0.03[c]
	10	3.15±0.07[a]	2.90±0.07[b]	2.76±0.06[bc]	2.60±0.05[c]
	15	3.65±0.07[a]	3.31±0.06[b]	3.10±0.05[c]	2.89±0.04[d]
	20	4.13±0.08[a]	3.66±0.08[b]	3.52±0.07[bc]	3.20±0.05[c]
	25	4.70±0.09[a]	4.02±0.08[b]	3.84±0.08[c]	3.48±0.06[d]
	30	5.23±0.12[a]	4.49±0. 11[b]	4.19±0.11[c]	3.83±0.09[d]

[a-d] Means within a column with the same superscript significantly different (P<0.05).

Values are expressed as Mean ± SE**.**

Sensory Evaluation:

Results in Tables (7, 8 and 9) shows that the changes in color, flavor and texture of fresh roes removed from ovaries of catfish *Clarias gariepinus* up to 30 days of storage which soaked in salt solution +7, 14 and 21 p.p.m nisin for 12 -15 hr. at 5ºC±1. during storage at room temperature. Color, flavor and texture significantly decreased (P < .0.05) during storage of all samples. Control and treated samples showed higher scores at zero day of storage period. Treatment samples which soaked in salt solution + 21 p.p.m nisin for 12 -15 hr. at 5ºC± showed the highest grade at the end of storage period.

Table 7: Changes in color of salted roes treated with different concentration of nisin during storage period at room temperature.

Treatment		Control	Salt with 7 p.p.m nisin	Salt with 14 p.p.m nisin	Salt with 21 p.p.m nisin
Storage period (days)	**0**	9.0 ±0.05[a]	9.0 ±0.06[a]	9.0 ±0.06[a]	9.0±0.05[a]
	5	7.4±0.06[d]	8.0±0.05[c]	8.3±0.06[b]	8.6±0.05[a]
	10	5.0±0.04[d]	6.7±0.05[c]	7.6±0.04[b]	8.1±0.06[a]
	15	3.7±0.03[d]	5.3±0.05[c]	6.5±0.05[b]	7.5±0.07[a]
	20	2.5±0.04[d]	4.0±0.04[c]	5.6±0.05[b]	6.8±0.06[a]
	25	2.0±0.03[d]	2.7±0.03[c]	4.5±0.04[b]	6.3±0.05[a]
	30	1.0±0.02[d]	2.0±0.03[c]	3.6±0.03[b]	5.6±0.04[a]

[a-d] Means within a column with the same superscript significantly different (P<0.05).

Values are expressed as Mean ± SE.

Table 8: Changes in flavor of salted roes treated with different concentration of nisin during storage period at room temperature.

Treatment		Control	Salt with 7 p.p.m nisin	Salt with 14 p.p.m nisin	Salt with 21 p.p.m nisin
Storage period (days)	0	9.5±0.04[a]	9.5±0.05[a]	9.5±0.05[a]	9.5±0.04[a]
	5	7.9±0.07[d]	8.5±0.06[c]	8.8±0.07[b]	9.1±0.06[a]
	10	5.5±0.05[d]	7.2±0.07[c]	8.1±0.06[b]	8.6±0.07[a]
	15	4.2±0.06[d]	5.8±0.06[c]	7.0±0.07[b]	8.0±0.08[a]
	20	3.0±0.04[d]	4.5±0.05[c]	5.8±0.07[b]	7.3±0.08[a]
	25	2.5±0.03[d]	3.2±0.04[c]	4.9±0.05[b]	6.8±0.06[a]
	30	1.6±0.02[d]	2.6±0.03[c]	4.1±0.04[b]	5.7±0.04[a]

[a-d] Means within a column with the same superscript significantly different (P<0.05).
Values are expressed as Mean ± SE.

Table 9: Changes in Texture of salted roes treated with different concentration of nisin during storage period at room temperature.

Treatment		Control	Salt with 7 p.p.m nisin	Salt with 14 p.p.m nisin	Salt with 21 p.p.m nisin
Storage period (days)	0	9.2±0.07[a]	9.2±0.07[a]	9.2±0.06[a]	9.2±0.07[a]
	5	7.6±0.06[d]	8.2±0.07[c]	8.5±0.07[b]	8.8±0.08[a]
	10	5.2±0.06[d]	6.9±0.05[c]	7.8±0.06[b]	8.2±0.07[a]
	15	3.9±0.04[d]	5.5±0.05[c]	6.7±0.05[b]	7.7±0.07[a]
	20	2.7±0.03[d]	4.2±0.05[c]	5.8±0.08[b]	7.0±0.08[a]
	25	2.2±0.03[d]	2.9±0.03[c]	4.7±0.05[b]	6.5±0.06[a]
	30	1.5±0.02[d]	2.2±0.03[c]	3.8±0.04[b]	5.8±0.05[a]

[a-d] Means within a column with the same superscript significantly different (P<0.05).
Values are expressed as Mean ± SE.

The gradual decrease in color, flavor and texture throughout storage could be attributed to the protein hydrolysis and its degradative products (TVBN) and fat oxidation which are considered major factors of changes in organoleptic properties. These results are in agreements with those given by Woyewoda and Bligh (1986); Mendonca *et al*. (1989); Khuntia *et al*. (1993) and Kim *et al*. (1995).

CONCLUSION

Surface treatment of salted roes (Batarekh) treated with different percentages of nisin up to 30 days of storage at room temperature which soaked in salt solution +7, 14 and 21 p.p.m nisin for 12 -15 hr. at 5ºC±1. during storage at room temperature prolonged shelf-life in all treatment samples kept at room temperature for 30 days. Roes soaked in salt solution without nisin was spoiled after 10 days of storage at roomtemperature. Accordingly treatment soaked in salt solution 21 p.p.m nisin are the best treatment to extend shelf-life of roes during storage at room temperature.

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ARABIC SUMMERY

تقييم الخواص الغذائية والجودة الحسية لبطارخ اسماك القراميط المملحة

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تمت دراسة بعض التغيرات الكيميائية، البكتريولوجيه وكذلك الخواص الحسيه لبطارخ اسماك القراميط الطازجة والتى وضعت فى محلول ملحى تركيزه (١٢% كلوريد صوديوم بالاضافة الى حمض خليك ٣,٥% وحمض الاسكوربيك ١% وبعض التوابل بنسبة ١,٥%) وقد أضيف لهذا المحلول الملحى نيسين بنسب ٧، ١٤، ٢١ جزء فى المليون لمدة ١٢-١٥ ساعه عقب ذلك حفظت لمدة شهر فى درجة حرارة الغرفة (٢٥±٥°م). حيث أظهرت الأسس الكيميائية للطزاجة والاحماض الدهنية والمحتوى البكتريولوجى وكذالك التقييم الحسى ميلا نحو الزيادة خلال فترة التخزين، وكان واضحا انخفاض مستوى التغير فى العينات المملحة والمنقوعة فى محلول ملحى ونيسين بنسبة ٢١ جزء فى المليون مقارنة بباقى العينات.