fish, shelf life was 15,6 days for iced and refrigerated storage and 13 months for frozen storage. However, Silver hake had shelf life of 6,5 days for iced, refrigerated storage and 14 months of frozen storage. In case of Shrimp, complete spoilage began after 6,1 days, I month of storage at 0,4 and –10 °C, respectively. Statistical analytical results indicated the presence of strong correlation between sensory scores and chemical parameters in all the examined fish and shellfish during storage period.

Key words: *Sea food, fish, shellfish, fish spoilage, mackerel, shrimp.*

INTRODUCTION

Fish spoilage was defined as a change in odor, taste and consistancy of fish or fish product that makes it unsafe, less acceptable to the consumer for its original intended purpose (Olley and Quarmby, 1981). Upon death, certain enzymes are inactivated and bacteria that are normally kept in check in the live fish now thrive on the proteins and fats, with the increase of the bacterial flora, decomposition of fish is rapid. Spoilage is therefore, the result of a combination of two factors enzyme activity (autolytic break down) and bacteria. The rate of spoilage depends largely on temperature, which controls to a large extent enzyme (autolytic) and bacterial break down. The rate also varies with species, amount of food in the gut, seasonality, gender age, geographical location. A part from intrinic factors such as moisture content, pH, onset of rigor mortis, chemical composition and redox potenial may influence spoilage in fish. Literally every stage from harvest to consumption affects spoilage in one way or another (Botta, 1995).

Fish are much more perishable than any other high protein muscle foods. The high degree of perishability is primarily due to the large amounts of non protein nitrogen (NPN) for example free amino acids, volatile nitrogen bases (ammonia), trimethylamine and histamine. The readily non protein nitrogen compounds support the post mortem bacterial growth. Therefore, the microbiological spoilage has been noted as the main cause of fish deterioration, followed by non microbioogical namely oxidative rancidity and then chemical or enzymatic denaturation of protein (autolytic spoilage). Generally in microbiological spoilage, bacteria are characterised both by their dominance in the microflora of spoiling fish and their ability to produce spoilage compounds. Accumulated metabolic products of bacteria are the primary causes of the organoleptic spoilage of raw fish. The microbial activity on reduced compounds, produced the characteristic fishy, ammoniac odours and change the texture to the slimy. Microbiological spoilage causes the formation of volatile bases principally ammonia, trimethylamine. These bases can be distilled, collected and made to neutralise acids. The amount of acid used is a measure of the total bases distilled and it corresponds with the level of spoilage or freshness indirectly. There are several procedures used for the determination of total volatile basic content and each procedure gives a different result for the same fish sample. The difference has been attributed to the way bases are released and distilled from the fish. (Kraft, 1992 and Botta, 1995).

However in chemical spoilage, after death fish lipids are subjected to two major changes, lipolysis and auto-oxidation. The main reactants in these processes involves atmospheric oxygen and fish lipids but the reactions are initiated and accelerated by heat, light (especially ultra violet light) and sveral organic and inorganic substances like copper and iron ions (Mayer and ward, 1991). The end products of lipolysis was liberation of free fatty acids and the primary products of auto-oxidation of lipids was peroxides. Almost immediately after peroxides are formed, the non conjugated double bonds ((c=c-c-c=c) that are present in the natural unsaturated lipids are converted to conjugated double bonds (c=c-c=c). Conjugated dienes absorb ultra violet radiation strongly at 233nm. Thus oxidation can be followed by dissolving the lipids in a suitable organic solvent and measuring the change in its absorbance with time using ultra violet spectrophotometer (Santiago *et al.,* 1997). During storage, In later stages of lipid oxidation, secondary oxidation products will usually be present and thus be indicative of a history of autoxidation. These products comprise aldehydes, ketones, short chain fatty acid and others, many of which have very unpleasant odours and flavours, and which in combination yield the fishy and rancid character associated with oxidized fish lipid. Some of the aldehydic secondary oxidation products react with thiobarbituric acid, forming a reddish coloured product that can be determined spectrophotometrically. Using this principle, a measure of thiobarbituric acid-reactive substances (TBA-RS) can be obtained. The results are expressed in terms of the standard (di-) aldehyde used, malonaldehyde, and reported as micromoles malonaldehyde present in 1 g of fat. (A note of caution: Sometimes the TBA-results may be expressed as mg malonaldehyde in 1 g of fat, or as amount of malonaldehyde (μmol or μg) in relation to amount of tissue analyzed.) In the autolytic spoilage, the enzymes and other related chemical reactions do not immediately cease their activities in the fish muscle. Their continuation initiates other precursor processes like rigor mortis, which is a basis for autolytic spoilage. The autolytic changes are responsible for the early quality loss in fresh fish but contribute very little to spoilage of chilled fish and fish products. However under frozen conditions, autolytic enzymes cause autolytic tissue damage which tends to be more pronounced in heavily feeding fish than petite feeders.

The bacterial and autolytic enzymes degradation are the parameters used to identify and quantitate sea food quality. Therefore, methods for evaluation of the degree of spoilage are essential. Of course, sensory methods are useful for identifying products of good or poor quality. A characteristic sensory changes in fish post mortem vary considerably depending on fish species and storage method. A characteristic pattern of the deterioration of fish stored in ice can be divided into four phases: phase one in which fish is very fresh and has a sweet, seaweedy and delicate taste. While in phase two, there is a loss of the characteristic odour and taste, the flesh become neutral but has no off flavours. The texture is still pleasant. In phase three, there is a significance of spoilage and a range of volatile unpleasant- smelling substances is produced depending on the fish species and type of spoilage (aerobic, anaerobic). In phase four, the fish can be characterized as spoiled and putrid (Nielsen, 1995). Chemical methods may best be used in resolving issues regarding products of marginal quality. In addition, chemical indicators have been used to replace more time consuming microbiological methods. Such objective methods should however correlate with sensory quality evaluations (Zdzislaw, *et al.,* 1990, Gram, 1992 and Hultin, 1992). Since,. Chemical and biological changes, which begin immediately after fish are harvested affect the quality of the product and affected by time and temperature. Therefore the objective of this work is to explain how time and temperature ultimately affect the quality (and thus acceptability) of fresh fish and shell fish and to follow changes in quality that occur during typical conditions of preservation and storage.

MATERIALS and METHODS

Sample preparation: A total of 100 samples of fresh fish and shellfish: Mackerel (Scomber scombrus), Horse mackerel (Treacherous trachurus), Silver hake (Merluccius bilinearis) and Shrimp (Penus

Table 2: summary of sensory and chemical quality evaluation of horse mackerel fish during cold storage

Storage temperature (degrees)	Holding time	Sensory scores (meanvalues± S.E)	Chemical parameter changes(meanvalues± S.D)	Chemical parameter changes(meanvalues± S.D)	Chemical parameter changes(meanvalues± S.D)	Chemical parameter changes(meanvalues± S.D)	Chemical parameter changes(meanvalues± S.D)
			T.V.N.(mg/100gm)	FFA(ml/gm)	AV(ml/gm)	CD(n mole/mg)	TBA(mgMA/kg)
0	0 (days)	8.56±0.157	19.89±0.602	0.554±0.0134	1.108±0.010	0.050±0.001	0.339±0.003
0	2	8.68±0.146	28.94±0.321	1.182±0.002	2.264±0.018	0.061±0.002	0.862±0.002
0	5	8.60±0.192	36.06±0.934	1.466±0.006	2.932±0.016	0.065±0.005	1.838±0.022
0	8	4.5±0.173	43.88±1.712	3.026±0.011	6.052±0.025	0.034±0.001	4.63±0.007
0	15	2.4±0.141	64.34±1.64	3.800±0.016	7.60±0.020	0.019±0.002	6.936±0.005
Total	15	6.55±0.162	38.622±1.042	2.006±0.010	4.012±0.015	0.046±0.002	2.921±0.008
4	0 (days)	8.56±0.157	19.89±0.602	0.554±0.0134	1.108±0.010	0.050±0.001	0.339±0.003
4	1	8.28 ±0.218	24.26±0.680	1.296±0.011	2.592±0.016	0.068±0.0004	0.926±0.006
4	3	4.50±0.159	32.18±0.832	1.588±0.013	3.176±0.010	0.073±0.002	2.354±0.008
4	4	4.36±0.150	59.916±1.116	2. 02±0.016	4.040±0.010	0.045±0.006	2.729±0.006
4	6	2.520±0.154	71.800±0.719	2.525±0.006	5.050±0.010	0.035±0.002	4.762±0.001
Total	6	5.644±0.167	41.609±0.790	1.597±0.012	3.194±0.011	0.054±0.003	2.222±0.005
-10	(months) 0	8.56±0.157	19.89±0.602	0.554±0.0134	1.108±0.010	0.050±0.001	0.339±0.003
-10	1	7.240±0.051	32.620±1.100	1.032±0.001	2.064±0.011	0.057±0.009	0.926±0.005
-10	3	4.100±0.045	45.99±0.740	1.608±0.013	3.216±0.002	0.017±0.004	2.354±0.006
-10	6	4.64±0.108	68.00± 0.796	2.300±0.002	4.600±0.010	0.018±0.002	3.729±0.003
-10	13	2.820±0.037	69.800±0.960	3.30±0.010	6.600±0.003	0.010±0.003	4.969±0.004
Total	13	5.472±0.080	59.08±0.838	1.759±0.008	3.518±0.007	0.030±0.001	2.463±0.004

Ascale from 0-10 was used .samples retaining odours and flavours typical for the species were given scores above6. Fish with slightly off odours and off flavours were given scores 4-5. Scores below 4 indicated objectionable strong unpleasant off-odours and off flavours.

Table 3: summary of sensory and chemical quality evaluation of silver hake fish during cold storage

Storage temperature (degrees)	Holding time	Sensory scores (meanvalues± S.E)	Chemical parameter changes(meanvalues± S.D) T.V.N.(mg/100gm)	Chemical parameter changes(meanvalues± S.D) FFA(ml/gm)	Chemical parameter changes(meanvalues± S.D) AV(ml/gm)	Chemical parameter changes(meanvalues± S.D) CD(n mole/mg)	Chemical parameter changes(meanvalues± S.D) TBA(mgMA/kg)
0	0 (days)	8.52±0.177	18.78±0.740	0.818±0.005	1.636±0.002	0.052±0.001	0.924±0.003
0	1	8.18±0.341	24.84±0.639	0.954±0.009	1.908±0.013	0.057±0.002	0.962±0.004
0	2	4.36±0.150	32.62±1.073	1.268±0.011	2.536±0.015	0.066±0.004	2.214±0.021
0	4	4.40±0.105	39.70±0.926	1.288±0.013	2.576±0.025	0.037±0.006	2.630±0.007
0	6	2.16±0.108	66.76±1.101	1.400±0.007	2.800±0.025	0.026±0.001	2.936±0.005
Total	6	5.524±0.176	36.540±0.896	1.146±0.009	2.292±0.016	0.048±0.003	1.858±0.008
4	0 (days)	8.52±0.177	18.78±0.740	0.818±0.005	1.636±0.002	0.052±0.001	0.924±0.003
4	1	8.200 ±0.352	24.04±0.365	0.847±0.002	1.694±0.019	0.062±0.002	0.956±0.002
4	2	4.440±0.191	29.720±1.028	0.898±0.005	1.796±0.010	0.069±0.004	2.186±0.001
4	4	4.480±0.183	57.720±0.687	1.00±0.003	2.000±0.006	0.043±0.006	2.356±0.006
4	5	2.320±0.146	64.50±0.740	1.420±0.004	2.840±0.010	0.022±0.002	2.729±0.003
Total	5	5.592±0.210	38.952±0.712	0.997±0.004	1.994±0.010	0.050±0.003	2.762±0.003
-10	0 (months)	8.52±0.177	18.78±0.740	0.818±0.005	1.636±0.002	0.052±0.001	0.924±0.003
	1	8.200±0.352	34.100±0.652	1.074±0.002	2.148±0.004	0.067±0.003	0.989±0.006
-10	3	4.500±0.173	57.18±1.193	1.672±0.010	3.344±0.009	0.071±0.002	2.145±0.001
-10	6	4.46±0.181	64.620±0.792	3.673±0.001	7.346±0.027	0.052±0.001	3.244±0.002
-10	14	2.52±0.143	77.52±0.893	4.630±0.005	9.260±0.001	0.038±0.003	5.560±0.004
Total	14	5.640±0.205	50.440±0.854	2.373±0.005	4.746±0.009	0.056±0.002	2.352±0.003

Ascale from 0-10 was used .samples retaining odours and flavours typical for the species were given scores above6. Fish with slightly off odours and off flavours were given scores 4-5. Scores below 4 indicated objectionable strong unpleasant off-odours and off flavours.

Table 7: Correlation coefficient between sensory scores and free fatty acids of the examined sea food during cold storage

Type of sea food	Storage temperatures (degrees)	Sensory scores(mean values)	Free fatty acid content (mean values) (ml/gm)	Correlation coefficient(r)
Mackerel				
	0	5.616	1.945	0.927
	4	6.550	1.698	0.942
	-10	5.780	2.622	0.881
Horse mackerel				
	0	6.550	2.257	0.845
	4	5.644	1.597	0.946
	-10	5.472	3.300	0.823
Silver hake				
	0	5.524	1.146	0.916
	4	5.592	2.007	0.824
	-10	5.640	2.370	0.851
shrimp				
	0	5.604	1.652	0.879
	4	5.300	1.860	0.893
	-10	6.527	2.631	0.906

Table 8: Correlation coefficient between sensory scores and acid number of the examined sea food during cold storage

Type of sea food	Storage temperatures (degrees)	Sensory scores(mean values)	Acid number (mean values) (ml/gm)	Correlation coefficient(r)
Mackerel				
	0	5.616	2.890	0.899
	4	6.550	3.396	0.937
	-10	5.780	5.244	0.879
Horse mackerel				
	0	6.550	4.514	0.925
	4	5.644	3.194	0.905
	-10	5.472	3.518	0.844
Silver hake				
	0	5.524	2.292	0.803
	4	5.592	4.014	0.798
	-10	5.640	4.740	0.700
shrimp				
	0	5.604	3.304	0.970
	4	5.300	3.720	0.940
	-10	6.527	5.262	0.874

Table 9: Correlation coefficient between sensory scores and conjugated dienes of the examined sea food during cold storage

Type of sea food	Storage temperatures (degrees)	Sensory scores(mean values)	conjugated dienes (mean values) (n molel/mg)	Correlation coefficient(r)
Mackerel				
	0	5.616	0.065	0.966
	4	6.550	0.069	0.944
	-10	5.780	0.049	0.908
Horse mackerel				
	0	6.550	0.046	0.905
	4	5.644	0.054	0.807
	-10	5.472	0.030	0.904
Silver hake				
	0	5.524	0.048	0.971
	4	5.592	0.050	0.877
	-10	5.640	0.056	0.840
shrimp				
	0	5.604	0.054	0.888
	4	5.300	0.039	0.873
	-10	6.527	0.051	0.887

Table 10: Correlation coefficient between sensory scores and thiobarbeturic acid number of the examined sea food during cold storage

Type of sea food	Storage temperatures (degrees)	Sensory scores (mean values)	thiobarbeturic acid number (mean values) (n mole/mg)	Correlation coefficient(r)
Mackerel				
	0	5.616	2.494	0.931
	4	6.550	2.524	0.876
	-10	5.780	2.919	0.908
Horse mackerel				
	0	6.550	2.921	0.891
	4	5.644	2.222	0.922
	-10	5.472	2.463	0.889
Silver hake				
	0	5.524	1.858	0.797
	4	5.592	2.762	0.898
	-10	5.640	2.352	0.891
shrimp				
	0	5.604	2.205	0.882
	4	5.300	1.984	0.807
	-10	6.527	3.980	0.758

DISCUSSION

In general, spoilage can be described as both a process (all deteriorative processes) and a result (result in products becoming unacceptable for human consumption). Fish and other sea food spoil very quickley, if they are not handled and treated properly. On the other hand it is possible to preserve fresh raw fish, so that it remains fresh just like when it caught for a long period of time, the four key factors to monitor for preserving the freshness of fish are time, temperature, care and hygiene.

Our results indicated that Mackerel fish stored at 0 °C (held on ice), for one day had good quality. However, at the second and fourth days of icing .it showed a decrease in quality but was other wise of acceptable quality, while at sixth day of storage, fish had compeletely spoiled. At the same time, mackerel fish stored at 4 °C in a refrigerator showed excellent quality at first day of storage, while it was at a border line quality at the second day and it became putrid, at the third day.

In case of mackerel fish stored at –10 °C it retained its excellent quality till three months and there was a decrease in quality at sixth month and complete spoilage was observed at 12th month (Table 1).

Mackerel fish is a fatty fish (a fat range through out the year is 6-23%) and is not normally gutted at the sea, therefore spoil quickly unless, they are chilled immediately after catching and kept chilled. The off odour of Mackerel with a fat content of 10%, will developed after 1-2 days, at 10 °C and will be putrid after 5-6 days, Fish with a high fat content spoil even faster. Mackerel of medium fat content stowed in ice or in refrigerated sea water immediately after capture will be in agood condition for 4-5 days (Smith, *et al.,* 1980, Suhendan, *et al.,* 2004).

Results of TBA values for Mackerel increased sharply between day 2 and day 3 and then fluctuated with rapid increases and decreases. Some of these changes may be due to sample variation and may reflect the usefluness of the test in the early stage of oxidation (Helen, 1989).

It was reported that mackerel fish stored at –18 °C for 10 months was rejected at the 10th month of the storage in the sensory evaluation (Alya and Ekim.1999).

Storage of krill fish at 0-2 °C after 6-8 hours of storage, a dark color started in the head, legs and spread slowly to the tail within 24 hours. After 72 hours, krill fish became inedible due to ammonical odor and flavour (Connell, 1990).

The total volatile nitrogen contents of mackerel fish stored at 0 °C 4 °C and –10 °C showed gradual increase from 24.84 mg/100gm to 64.14 mg/100gm until day six of icing, from 24.84 mg/100gm to 61.54 mg/100 gm until day three of refrigeration and from 24.84 mg/100gm to 69.28mg/100gm until tenth month of frozen storage, respectively (Table1).

It was found that total volatile nitrogen contents of Mackerel fish began to increase sharply around day 2 and continued rising around day 6 at 0-4 °C in a refrigerator (Helen, *et al.,* 1989).

It was reported that a large increase in TVBN in Mackerel after 10 days chilling (Gill, *et al.,* 1992).

Results of Table (1) indicated that mackerel fish stored at -10 °C for 12 months showed the highest mean concentration of free fatty acids and acid value (3.3600ml/gm, 6.72ml/gm), while fresh fish, had the lowest (1.194ml/gm, 2.388 ml/gm) (Table1). At the same time, fresh Mackerel fish showed the highest mean concentration of conjugated dienes (CD) (0.122 nmole/mg) while mackerel stored at –10 °C for 12 months had the lowest (0.009 nmole/mg). However, TBA mean concentration was increased from 0.806mgMA/kgm of fresh fish to 4.194 mgMA/kgm of mackerel stored at 0 °C for 6 days, to 4.786 mgMA/kgm of fish stored at 4 °C for three days and to 6.348mgMA/kgm of fish stored at –10 °C for 12 months, respectively (Table1).

Results of sensory analysis of the iced salmon indicated that both the pink and coho salmon retained their excellent quality (prime quality) characteristics for about 8 days post harvest. The chemical indicator for oxcidative rancidity (TBARS) in premium grade iced pink and coho salmon do not exceed 2.5 micromoles MA./100gm.After 3 months in frozen storage at –23 °C, the pink and coho salmon were of acceptable quality after 3 and 6 months, respectively but less than premium quality because of rancidity. About 9 days into the experiments, the iced pink salmon showed loss of quality. After 14 days, it showed compelete signs of spoilage (poor quality). In case of iced coho salmon, loss of quality appeared after9 days on ice and compelete spoilage after 13 days on ice.it was also found that between 9,11 days, there was an increase in TBA number of pink salmon (indicating that the additional time on ice created a window of susceptibility that premitted increased oxidation of fatty acids in the oils of pink salmon). Low TBA numbers found in the coho salmon indicated that, as expected, oxidation of lipids was not as much of a probable as it was with the pink salmon, at the same time, this was verified by taste panel evaluations which indicated no organoleptic highest levels of TVN (118.30 mg/100g) was found in Shrimp stored at 0 °C for 6 days while the lowest was in fresh shrimp 30.96mg/100gm). In case of free fatty acids, fresh Shrimp showed the lowest (1.03ml/gm) while the highest (4.467 ml/gm) was in shrimp stored at –10 °C for 10 months. Concerning acid value, fresh Shrimp had the lowest value (2.060 ml/gm), while Shrimp stored for one month at –10 °C showed the highest (8.934ml/gm). Regarding lipid oxidation parameters (CD, TBA) the conjugated dienes decreased with the progress of spoilage during storage at different temperatures and the vise versa was true for TBA values.

It was reported that the whole Shrimp samples stored in a refrigerator (+4 °C) were found to be of excellent (prime) quality at day 0, good quality (less than excellent) at day 1 and spoiled after 2 days, according to findings of sensory, chemical and physical analyses. The total volatile nitrogen (mg/100gm) ranged from 22.95 mg/100gm to 109.15 mg/100gm, during storage for 4 days (Candan, *et al.* 2000).

T.V.N of 50mg/100gm in peeled Shrimp represent such an objective lower limit if a comparison with organoleptic assessement is made. The maximum storage period in ice was 7 days (Solberg and Nesbakken, 1981).

It was reported that 30 mgTVBN/100gm in shrimp meat used as indicator limit for Shrimp acceptability (Solberg and Nesbakken, 1981). Thanae, *et al.,* (2003) found that the TVBN mean values of farm, fresh marine (brackish) and frozen shrimp (imported) were 2.542 mg/100 gm, 14.182 mg/100gm, 27.16mg/100gm., respectively. Otherwise, frozen Shrimp had the highest significant values which attributed to denaturation of protein during frozen storage. At the same time, TBA values were 0.801mg MA/kg for frozen shrimp, 0.308 for farm Shrimp and 0.182 mg MA/kg for marine fresh Shrimp (Thanae, *et al.,* 2003).

Triplicate sensory evaluations of each decomposition increment at 0,12,24,36 °C were conducted by three FDA sea food sensory experts. Sensory and chemical evaluation of Shrimp showed that decomposition more rapidly progressed at high temperatures than at low temperatures. It were considered to be decomposed by sensory evaluation on day 14 at 0 °C (Benner and Otwell, 2003).

Total volatile bases (TVB) of fish stored at low temperature, showed an increase, particularly at 5°C; at this temperature, values above 30 mgN/100g were reached after 5 days storage at 5°C (Shamsad, *et al.,* 1990, Huss, 1993, Holt, 1994,).

It was found that white Shrimp (penaeus setiferus) stored on ice, at 4 °C in refrigerator at zero time showed TVN of 18mg/100gm. (Solbergan and Nesbakken, 1981)

Whole Shrimp raw, will keep in good condition in cold storage at –30 °C for at least 6 months, individually frozen whole shrimp will keep for 3-4 months in good condition at –20 °C and only one month at –10 °C (Fatima, *et al.,* 1988 and Candan, *et al.,* 2000).

In the present study, the results of table (5) showed that the shelf life of the examined sea food during cold storage, where the shelf life of Mackerel fish was 6days, 3 days for storage at 0,4 °C and 12 months for storage at –10 °C respectively.In case of Horse mackerel fish, the shelf life was 15,6 days for storage at 0 and 4 °C respectively. While storage of Horse mackerel at –10 °C had shelf life of 13 months. Regarding Silver hake fish, it had shelf life of 6 and 5 days of storage at 0 and 4 °C respectively. while storage at –10 °C Silver hake fish showed shelf life of 14 months. At the same time, Shelf life of Shrimp was 6 days, 1 day and one month for storage at 0,4 and -10 °C respctively. The shelf life of stuffed rain bow trout during cold storage, (refrigerator) was to be 5 days. (Baygar, *et al.,* 2002).

The microflora responsible for spoilage of fresh fish changes with changes in storage temperature. Storage of fish at temperatures between 0°C and -4°C is called superchilling or partial freezing. The shelf life of various fish and shellfish can be extended by storage at subzero temperatures. Superchilling extends the shelf life of fish products. The technique can be used, for example where productive fishing grounds are so far from ports and consumers that normal icing is insufficient for good quality products to be landed and sold. (Aleman, *et al.,* 1982).

It was found that the shelf life of Silver hake stored at 0 °C (held in ice) was 4-5 days (Hiltz, *et al.,* 1976).

Samples of lean fish, fatty fish,and black tiger shrimp were tested using sensory evaluation parameters. They were preclassed1-3byodor, colorandtextureofthe muscle tissue (class 1 indictes excellent qualiy, class2 has border line quality and class3 showed bad quality. (Christopher, *et al.,* 1997).

Fish (especially the oily varieties) transported for four weeks at -18 °C C will lose the equivalent of 16 weeks of shelf life due to the high transport temperature. Conversely, if the fish is transported for the same four weeks at -35 °C, it loses only two weeks of shelf life. Many times, frozen fish is stored at the destination for a considerable amount of time in anticipation of market price shifts. Extended shelf life at premium (excellent) quality is an important factor in the business. Since it is possible that a product will stay in storage longer than originally intended, it is generally safer to use the lower recommended temperature (Jorgensen, *et al.,* 1988).

The shelf life study of Shrimp stored in ice was over a 9 days period (Candan, *et al.,* 2000).

Results of correlation between sensory scores and TVN value (Tables 7, 8, 9, 10) of the examined sea food during storage period at different temperatures (0,4,-10 °C) indicated the presence of a strong correlation (r=0.826-0.987) (Table 6). however, there was a strong correlation with FFA (r=0.823-0.946). sensory scores also correlated well with acid value (r=0.700-0.970) In case of CD and TBA as a lipid oxidation products, they were positively correlated with sensory scores (r=0.807 -0.971,r=0.758-0.931)

Several reports by Hovland and Taylor (1991) speak of some correlation between TBA-RS and sensory assessments, but other authors fail to find a correlation (Connell, *et al.,* 1975). Thus, caution is necessary in interpretation of TBA-RS values into measures of sensory quality. Examples of guidelines for TBA-RS-values: foods with TBA-RS above 1-2 µmol MDA-equiv per g fat (Connell, *et al.,* 1975) or above 10, µmol MDA-equiv per 1 kg fish (Ke and Woyewoda, 1976) will probably have rancid flavours.

There was insignificant correlation between sensory rancid odor and and thiobarbeturic acid test results where there was an increase in TBA values in Mackerel, Horse mackerel and Silver hake without development of rancid odor (Kolakowska and Denty, 1983).

It was reported that the lipid oxidation parameters (TBA, FFA) were increased significantly in Chub mackerel (Scomber japonicus) stored at –18 °C for 10 months. The sensory scores of the samples were in the same parallel with chemical results with respect to flavour and general acceptability (Alya and Ekim, 1999).

It was found that the mean sensory scores (flavor) and corresponding mean TBA numbers for the iced pink salmon correlated well (r=0.87) suggesting that rancidity had as much to do with loss of quality as microbial and chemical degredation, at the mean time, low levels of TBA of coho salmon, correlated with results of sensory evaluation indicating that, the presence of low levels of chemical rancidity did not greatly influence the overall quality of the coho salmon.

The greatest increases in chemical parameters (TVN, TBA) were found between days 2 and 4 of flounder fish stored at 5 °C. After 4 days of storage, the flounder was considered spoiled by organoleptic criteria. The results also showed that although the chemical and organoleptic measures of spoilage overlapped, organoleptic indication of spoilage lagged behind the chemical markers (Gill, 1992).

It was stated that TVBN of gutted mediterranean hake (Merluccius merluccius var Mediterrancus) stored for up to 20 days in ice in different seasons of the year, was not correlated with the time of ice storage and proved to be better as a spoilage index than a freshness index (Baixas, *et al.*, 2003).

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