# Quality Assessment of Nile Tilapia and Grey Mullet Fish Collected from Different Local Markets in Alexandria City, Egypt

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## ABSTRACT

This study was conducted to determine quality parameters of Nile tilapia (*Oreochromis niloticus*) and grey mullet (*Mugil cephalus*) which were collected from different local markets in Alexandria city, Egypt during 2015. According to the overall sensory scores, the Nile tilapia and mullet samples collected from the different local markets could be classified into three categories of quality grade as follows: High quality grade (score between 8 to 10), acceptable grade (score between 5 to 7.9) and unacceptable grade (less than 5).

The TVB-N values in the different samples were below the maximum value of 30 mg N/100g flesh (upper limit according to E. O. S. Q. C., 2005, ES: 3494). The TMA-N value of Nile tilapia and grey mullet collected from the different markets were within the recommended standard limits for acceptability.

The pH values of Nile tilapia varied from 7.01 to 7.38. The data obtained showed significant differences ($P<$ 0.05) among the samples. Further, Hanuvil market samples had the highest value of pH, while samples collected from El Wardian market had the lowest value of pH, with no significant differences between El Wardian, Alqsy and Bab Omar Pasha market samples. It was found that the pH values of grey mullet samples ranged from 6.74 to 7.18. Hanuvil samples followed by El Amreya samples were recorded to have the highest value of pH with no significant difference between them. On the other hand, Bakkous samples followed by Zananiri samples showed the lowest value of pH with no significant difference between them.

The results indicated that the psychrophilic bacterial count of Nile tilapia and grey mullet collected from different markets were higher than mesophilic bacterial count. All Nile tilapia and grey mullet samples had high quality considering that the microbiological upper limit for fresh fish proposed by E. O. S. Q. C. (2005, ES: 3494) not exceed $10^6$ CFU/flesh.

***Key words: Nile tilapia, grey mullet, quality, sensory evaluation, bacteriological evaluation, TNB-N, TMA, pH.***

## INTRODUCTION

Nowadays, there is an increasing demand on fish which act as an important source of food around the world (Silva *et al*., 2011). The share of fisheries production used for direct human consumption increased from about 70 % in the 1980s to more than 85 % in 2012 (FAO, 2014).

Egypt has one of the world's largest aquaculture sectors which makes a significant contribution to income, employment creation and food security. Animal source foods provide important sources of energy, micro and macro nutrients, but are commonly associated with food borne diseases. Livestock and fish value chains support the livelihoods of millions of rural and urban poor, for whom they can act as pathways out of poverty (ILRI, 2011).

A recent value chain analysis of the industry revealed that the farmed fish value chain in Egypt is mainly based on the production of Tilapia with Mullet; the first and second most important species on private fish farms. Other species of fish such as carp and catfish are farmed in small quantities (Eltholth *et al*., 2015).

Tilapia and Mullets are the most important fish species for mono and polyculture in Egypt. Nile tilapia (*Oreochromis niloticus*) constitutes about 70% of the Nile and lakes catch. They are important for their palatability, high nutritive value, reasonable price, high growth rate, reproduction and tolerance to adverse water quality (Balarian, 1979 & Ishak, 1980).

Fish is one of the most highly perishable food products. During handling and storage quality deterioration of fresh fish rapidly occurs and limits the

shelf life of the product. Most of the methods that have been used to estimate the quality of fresh fish measure or evaluate parameters that change, disappear or formed during deterioration of fish. These methods may be divided into several groups such as bacteriological and chemical methods (Huss, 1995).

Methods for evaluating freshness and quality of different marine species are based on measurements of post mortem changes associated with sensory, chemical, physical changes and bacteriological growth (Ocaño-Higuera *et al*., 2011).

There is little information regarding the quality assessment of Nile tilapia and grey mullet from different local markets in Egypt. Therefore, the present study was undertaken to evaluate quality and freshness of Nile tilapia and grey mullet using sensorial, chemical and bacteriological attributes.

## MATERIALS AND METHODS

### Materials

A total of 15 different samples of fish (*Oreochromis niloticus* & *Mugil cephalus*) were collected from different local markets in Alexandria city, Egypt during 2015 (Table 1).

The edible portion of the meat from each sample was removed, homogenized using blender (Braun type: 4262).

**Table 1: Local markets in Alexandria city**

| The region (district) | Market name |
|---|---|
| Montazah district | El Maamoura market<br>Asafra market<br>Derbala market |
| East Alexandria district | Bakkous market<br>Zananiri market<br>Alqsy market |
| The center of Alexandria district | Shedia market<br>Gheat Elsaaeidy market<br>Zine Elabidine market |
| West Alexandria district | El Wardian market<br>Bab Omar pasha market<br>El Maydan market |
| El Amreya district | Hanuvil market<br>Dekhela market<br>El Amreya market |

### Methods

#### Sensory evaluation

Sensory evaluation of raw tilapia and mullet was performed by ten trained panelists chosen from the staff members of the Department of Food Science and Technology, Faculty of Agriculture, Alexandria University. The organoleptic assessment of raw tilapia and mullet were made according to the scale described by Barile *et al*. (1985). This scale ranged from zero (extremely unacceptable) to 10 (highly acceptable) for the following characteristics: acceptability, eye, pupil gills, body surface (appearance), odour, texture, flesh condition, viscera and belly wall.

Sensory evaluation of steamed cooked tilapia and mullet samples was applied after steaming in lidded aluminum pan for 10 min. The panelists were asked to score the organoleptic properties of the sample by giving scores ranged between 0 to 10 as described by Barile *et al*. (1985).

#### Total volatile basic-nitrogen (TVB -N)

Fish extracts for determination of TVB-N were prepared by homogenizing 10 g fish sample with 90 ml 7.5% (w/v) aqueous trichloroacetic acid (TCA) solution using a laboratory homogenizer for 1 min at high speed. The homogenate was centrifuged at 1409×g for 5 min and the supernatant was filtered through Whatman No. 1 filter paper. The TVB -N were measured by steam- distillation of the TCA -fish extract, using the method of Malle & Tao (1987). Twenty-five ml of the filtrate were added to a Kjeldahl- type distillation tube, followed by 5 ml of 10% (w/v) aqueous NaOH solution. Steam distillation was performed using a vertical steam distillation unit and the distillate was received into a beaker containing 15 ml of 4% (w/v) aqueous boric acid and 0.04 ml of methyl red and bromocresol green indicator solution up to a final volume of 50 ml. The titration was allowed to run against aqueous 0.05 M sulphuric acid solution. The results were expressed as mg nitrogen per 100g fish sample.

#### Trimethylamine (TMA)

Trimethylamine (TMA) was determined in one run with the TVB-N according to the method described by AMC (1979). The nitrogen content of these volatile bases which did not react with formaldehyde was calculated, as TMA. After the back titration of excess acid during the determination of TVB-N, aliquot of 1 ml of 16% (w/v) formaldehyde solution was added for every 10 ml liquid in the titration flask in order to make amines other than TMA react with formaldehyde and the acid released was titrated with standard alkali. The results were expressed as mg nitrogen per 100g fish sample.

**pH value**

Five g of fish sample were homogenized in 50 ml distilled water at the ratio 1:10 (w/v) using laboratory Warring blender and the pH was measured using a digital pH meter (pH 211, Microprocessor pH). The pH meter was calibrated using buffers of pH 4 and 7 (Goulas & Kontominas, 2007).

**Bacteriological analysis**

Ten g of flesh were transferred into 90 ml 0.1% peptone water. From this dilution, other decimal dilutions were prepared. Total psychrophilic and mesophilic bacterial count were determined by the pour plating technique, using plate count agar (PCA) and the plates were inverted and incubated in an incubator at 35$^{o}$C for 48 hr for mesophilic bacteria and at 7-10$^{o}$C for 10 days for psychrophilic bacteria (Bahmani *et al*., 2011).

Finally, the number of colonies were counted and multiplied by dilution factor to calculate the total colonies forming units per g sample (Abelti, 2013).

**Statistical analysis**

Analysis of variance and correlations were carried out according to Gomez & Gomez (1984) using SAS (Statistical Analysis System) ver.9.1, 2000.

## RESULTS AND DISCUSSION

### Nile tilapia collected from different markets

**Sensory evaluation**

The data for sensory evaluation of raw and steamed Nile tilapia samples collected from different local markets in Alexandria city are presented in Tables (2 & 3). The values were calculated as means of ten scoring evaluations.

The results indicated that the sensory evaluation scores of Nile tilapia samples collected from different local markets in Alexandria city varied significantly. Also, as shown from Tables (2 & 3), the overall acceptability scores varied from 4.9 to 9.9 and from 5.3to 9.9 for raw and steamed samples, respectively.

The highest overall acceptability was detected in Shedia and Zananiri market samples, while the lowest overall acceptability score was recorded in samples collected from Hanuvil and Derbala markets for both raw and steamed samples. This may be attributed to the higher bacterial load of samples collected from Hanuvil and Derbala markets compared to those obtained from the other markets (Table 4).

The overall sensory scores less than 5 points mean that Nile tilapia samples are organoleptically rejected (Barile *et al*., 1985). According to the overall sensory scores (Tables 2 & 3), the samples collected from different local markets could be classified into three categories of quality grade as follows: (1) high quality grade (samples collected from Shedia, Zananiri, Zine Elabidine, Alqsy, El Wardian and Bab Omar pasha markets) (2) acceptable grade (samples collected from Gheat Elsaaeidy, Bakkous, El Maydan, El Maamoura, Asafra , Derbala ,Dekhela and El Amreya markets), (3) unacceptable grade (Hanuvil market samples).

**The TVB-N of tilapia**

The results in Table (4) show TVB-N of Nile tilapia collected from different local markets in Alexandria city. According to these data, it can be concluded that the TVB-N content of the market samples ranged from 10.21 to 26.77 mg N/100g flesh. It was found that the TVB-N value varied significantly ($P< 0.05$) between different market samples. Meanwhile, Hanuvil market samples had the higher amount of TVB-N, while samples collected from Bab Omar pasha market had the lower level of TVB-N with no significant differences observed between El Wardian, Alqsy and Bab Omar pasha market samples.

Differences in levels of TVB-N may be due the activity of proteolytic enzymes by bacterial action which produced some volatile compounds under low temperature (Nunes *et al*., 1992, Abou-Taleb & Ibrahim, 2002). Also, Mazorra-Manzano *et al*. (2000) reported that this increment may be due to ammonia production in the muscle during storage from bacterial catabolism of nitrogen, due to the fact that TVB-N levels still rise as a result of the $NH_3$ formation and other volatile amines.

It was clear that all concentrations of TVB-N are lower than the safety limits suggested by CEC (1995), Connell (1995), Huss (1995), Gökodlu *et al*. (1998), Lopez-Caballero *et al*. (2000), E.O.S.Q.C. (2005), Muhammet & Sevim (2007) and Liu *et al*. (2010), which set TVB-N values of 30-35 mg N/100g flesh regarded as the limit of acceptability.

**Table 2: Sensory evaluation*of raw Nile tilapia samples**

| Market name | Sensory quality parameters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Eye | Gills | Body surface | Odour | Texture | Flesh condition | Viscera | Belly wall | Overall acceptability |
| Shedia | 9.7$^{a}$±0.48** | 9.4$^{ab}$±0.69 | 9.5$^{a}$±0.53 | 9.9$^{a}$±0.32 | 9.9$^{a}$±0.32 | 9.7$^{a}$±0.67 | 9.8$^{a}$±0.63 | 9.9$^{a}$±0.32 | 9.90$^{a}$±0.32 |
| Gheat Elsaaeidy | 7.4$^{d}$±0.70 | 7.5$^{d}$±0.71 | 7.5$^{d}$±0.71 | 7.4$^{d}$±0.70 | 7.5$^{de}$±0.71 | 7.5$^{d}$±0.71 | 7.3$^{d}$±0.82 | 8.7$^{c}$±0.70 | 7.4$^{e}$±0.52 |
| Zine Elabidine | 8.8$^{bc}$±0.79 | 8.8$^{bc}$±0.63 | 8.5$^{c}$±0.70 | 8.8$^{bc}$±0.92 | 8.7$^{c}$±0.67 | 8.7$^{c}$±0.82 | 8.7$^{c}$±0.67 | 7.1$^{d}$±0.67 | 9.1$^{bc}$±0.88 |
| Bakkous | 6.9$^{d}$±0.57 | 7.1$^{d}$±0.89 | 7.0$^{d}$±0.67 | 7.0$^{d}$±0.91 | 7.0$^{e}$±0.82 | 7.1$^{d}$±0.74 | 7.1$^{d}$±0.74 | 7.1$^{d}$±0.74 | 7.1$^{e}$±0.74 |
| Zananiri | 9.6$^{a}$±0.69 | 9.5$^{a}$±0.71 | 9.6$^{a}$±0.51 | 9.8$^{a}$±0.67 | 9.6$^{a}$±0.70 | 9.7$^{a}$±0.48 | 9.6$^{a}$±0.52 | 9.7$^{ab}$±0.48 | 9.8$^{a}$±0.42 |
| Alqsy | 8.8$^{bc}$±0.79 | 8.8$^{bc}$±0.63 | 8.6$^{bc}$±0.84 | 8.8$^{bc}$±0.42 | 9.0$^{bc}$±0.82 | 8.8$^{bc}$±0.92 | 8.9$^{bc}$±0.88 | 8.7$^{c}$±0.67 | 8.9$^{cd}$±0.74 |
| El Wardian | 9.3$^{ab}$±0.67 | 9.3$^{ab}$±0.48 | 9.2$^{ab}$±0.63 | 9.4$^{ab}$±0.92 | 9.4$^{ab}$±9.52 | 9.3$^{ab}$±0.67 | 9.4$^{ab}$±0.52 | 9.3$^{b}$±0.67 | 9.5$^{ab}$±0.53 |
| Bab Omar pasha | 8.4$^{c}$±0.52 | 8.3$^{c}$±0.48 | 8.3$^{c}$±0.67 | 8.4$^{c}$±0.70 | 8.6$^{c}$±0.52 | 8.5$^{c}$±0.53 | 8.5$^{c}$±0.53 | 8.3$^{c}$±0.48 | 8.5$^{d}$±0.71 |
| El Maydan | 6.0$^{e}$±0.82 | 6.1$^{e}$±0.48 | 5.8$^{e}$±0.92 | 6.0$^{e}$±0.67 | 6.1$^{f}$±0.88 | 5.9$^{e}$±0.57 | 6.1$^{e}$±0.74 | 5.9$^{e}$±0.73 | 6.2$^{f}$±0.63 |
| El Maamoura | 5.9$^{e}$±0.74 | 6.0$^{e}$±0.74 | 5.7$^{e}$±0.67 | 5.8$^{e}$±0.79 | 6.1$^{f}$±0.74 | 5.8$^{e}$±0.63 | 5.9$^{e}$±0.74 | 5.6$^{e}$±0.84 | 5.8$^{f}$±0.63 |
| Asafra | 7.4$^{d}$±0.52 | 7.6$^{d}$±0.82 | 7.6$^{d}$±0.52 | 7.6$^{d}$±0.52 | 7.6$^{d}$±0.52 | 7.6$^{d}$±0.52 | 7.5$^{d}$±0.53 | 7.6$^{d}$±0.52 | 7.6$^{e}$±0.52 |
| Derbala | 4.7$^{f}$±0.95 | 4.9$^{f}$±0.52 | 5.0$^{d}$±0.47 | 4.4$^{f}$±1.07 | 4.9$^{g}$±0.57 | 4.6$^{f}$±0.69 | 4.5$^{f}$±0/85 | 4.3$^{f}$±0.95 | 5.1$^{g}$±0.73 |
| Hanuvil | 4.6$^{f}$±0.84 | 4.8$^{f}$±0.89 | 4.8$^{f}$±0.79 | 4.5$^{f}$±0.97 | 4.7$^{g}$±0.67 | 4.5$^{f}$±0.85 | 4.6$^{f}$±0.51 | 4.6$^{f}$±0.52 | 4.9$^{g}$±0.57 |
| Dekhela | 7.1$^{d}$±0.73 | 7.2$^{d}$±0.92 | 7.4$^{d}$±0.84 | 7.3$^{d}$±0.82 | 7.3$^{de}$±0.67 | 7.2$^{d}$±0.92 | 7.1$^{d}$±0.88 | 7.2$^{d}$±0.92 | 7.5$^{e}$±0.53 |
| El Amreya | 5.8$^{e}$±1.03 | 6.1$^{e}$±0.74 | 6.0$^{e}$±0.67 | 6.2$^{e}$±0.79 | 5.9$^{f}$±0.74 | 5.8$^{e}$±0.63 | 5.8$^{e}$±0.91 | 5.9$^{e}$±0.57 | 6.1$^{f}$±0.74 |
| L. S. D. | 0.67 | 0.64 | 0.6 | 0.66 | 0.6 | 0.59 | 0.64 | 0.59 | 0.53 |

*High grade: Overall sensory scores between 10 and 8.
Acceptable grade: Overall sensory scores less than 8 and more than 5.
Unacceptable grade: Overall sensory scores 5 or less.
**Data as mean ± SD.
Means in the same column sharing the same letters are not significantly different at $P< 0.05$ level.
The values were calculated as means of 10 scoring evaluations.

**Table 3: Sensory evaluation* of steamed Nile tilapia samples**

| Market name | Sensory quality parameters | | | |
|---|---|---|---|---|
| | Odour | Taste | Texture | Overall acceptability |
| Shedia | $9.8^{a}\pm0.42$** | $9.6^{a}\pm0.70$ | $9.8^{a}\pm0.43$ | $9.9^{a}\pm0.32$ |
| Gheat Elsaaeidy | $7.8^{e}\pm0.63$ | $7.6^{e}\pm0.52$ | $8.0^{de}\pm0.47$ | $8.2^{de}\pm0.42$ |
| Zine Elabidine | $8.9^{bc}\pm0.74$ | $8.6^{b}\pm0.69$ | $8.8^{b}\pm0.79$ | $9.1^{bc}\pm0.74$ |
| Bakkous | $7.7^{e}\pm0.95$ | $7.7^{e}\pm0.67$ | $7.8^{e}\pm0.79$ | $7.9^{e}\pm0.74$ |
| Zananiri | $9.7^{a}\pm0.48$ | $9.3^{a}\pm0.82$ | $9.7^{a}\pm0.48$ | $9.8^{a}\pm0.42$ |
| Alqsy | $8.6^{cd}\pm0.70$ | $8.4^{bc}\pm0.69$ | $8.6^{bc}\pm0.69$ | $8.7^{cd}\pm0.82$ |
| El Wardian | $9.5^{ab}\pm0.53$ | $9.2^{a}\pm0.79$ | $9.4^{a}\pm0.51$ | $9.6^{ab}\pm0.52$ |
| Bab Omar pasha | $8.6^{cd}\pm0.52$ | $8.3^{bcd}\pm0.48$ | $8.5^{bcd}\pm0.52$ | $8.9^{c}\pm0.93$ |
| El Maydan | $6.3^{f}\pm0.67$ | $6.0^{f}\pm0.47$ | $6.1^{f}\pm0.74$ | $6.1^{f}\pm0.74$ |
| El Maamoura | $6.4^{f}\pm0.84$ | $6.0^{f}\pm0.67$ | $6.0^{f}\pm0.66$ | $6.1^{f}\pm0.73$ |
| Asafra | $8.1^{de}\pm0.57$ | $7.8^{de}\pm0.78$ | $8.3^{bcde}\pm0.67$ | $8.0^{e}\pm0.47$ |
| Derbala | $5.0^{g}\pm0.94$ | $5.2^{g}\pm0.63$ | $5.2^{g}\pm0.78$ | $5.3^{g}\pm0.48$ |
| Hanuvil | $4.9^{g}\pm0.87$ | $4.8^{g}\pm0.79$ | $5.0^{g}\pm0.82$ | $5.4^{g}\pm0.52$ |
| Dekhela | $8.0^{de}\pm0.47$ | $8.0^{cde}\pm0.67$ | $8.1^{bcde}\pm0.32$ | $8.2^{de}\pm0.42$ |
| El Amreya | $6.2^{f}\pm0.63$ | $6.0^{f}\pm0.47$ | $6.2^{f}\pm0.42$ | $6.4^{f}\pm0.52$ |
| L. S. D. | 0.6 | 0.58 | 0.55 | 0.53 |

*High grade: Overall sensory scores between 10 and 8.
Acceptable grade: Overall sensory scores less than 8 and more than 5.
Unacceptable grade: Overall sensory scores 5 or less.
**Data as mean ± SD.
Means in the same column sharing the same letters are not significantly different at $P<0.05$ level.

**The TMA-N of tilapia**

The results in Table (4) reveal that the TMA-N of Nile tilapia collected from different local markets in Alexandria city varied between 5.13 to 8.21 mg N/100g flesh. TVB-N value varied significantly ($P< 0.05$) between different market samples.

Hanuvil sample had the highest value of TMA-N. On the other hand, Bab Omar pasha samples followed by El Wardian samples showed the lowest value of TMA-N, with no significant difference between them.

From the results obtained in the present study, it can be concluded that a correlation was observed between the results of TMA-N and bacterial load. In accordance with the results obtained here, El Marrakchi *et al*. (1990) mentioned that The TMA production in fish tissue could be used as an indicator of bacterial activity and it is an accepted deterioration measure.

The TMA-N value of Nile tilapia collected from the different local markets in Alexandria city was below rejection limit of TMA-N proposed by Huss (1978), AOAC (1984), FAO (1986), & Ruiz-Capillas & Moral (2001) which is within the range of recommended limit of rejection of 10 to 18 mg N/100g. Also, TMA-N value was blew rejection limit of many fish species which is usually from 5-10 mg TMA-N /100g muscles as reported by Fathia *et al*. (2013).

**The pH values of tilapia**

The pH values of Nile tilapia collected from different local markets in Alexandria city are summarized in Table (4). The data obtained show significant differences ($P< 0.05$) among the samples collected from the different markets.

The pH values of Nile tilapia varied from 7.01 to 7.38. Further, Hanuvil market samples had the highest value of pH. On the other hand, El Wardian, Alqsy and Bab Omar Pasha market samples exhibited the lowest value of pH with no significant difference between them. This result is consistent with the results of TVB-N, TMA-N and microbial load.

The results in the present study showed that pH value was above value of 7. The increment in pH may also be due to an increase in total volatile bases

from the decomposition of nitrogenous compounds by endogenous or microbial enzymes and this corroborates with the increase in TVB- N. These results agreed with those previously reported (Khallaf, 1986, Galli *et al*., 1993, Kyrana *et al*., 1997, Pacheco-Aguilar *et al*.,2003, Daramola *et al*., 2007, Erkan & Ozden, 2008, Okeyo *et al*., 2009, Salaudeen *et al*., 2010, Goliat *et al*., 2016 Moawad *et al*., 2017). Such an increment in the pH indicates the bacterial growth, loss of quality and possible spoilage (Sallam *et al*., 2007, Moawad *et al*., 2017).

**Bacterial count of tilapia**

Bacterial count of Nile tilapia collected from different local markets in Alexandria city are given in Table (4). The data obtained showed significant differences ($P< 0.05$) among the samples collected from the different markets for both mesophilic and psychrophilic bacterial count.

The mesophilic bacterial count ranged from $8.47x10^2$ CFU/g flesh to $9.83x10^4$ CFU/g flesh for Zine Elabidine and Hanuvil market samples, respectively. On the other hand, the psychrophilic bacterial count ranged from $9.73x10^2$ CFU/g flesh to $5.17x10^5$ CFU/g flesh for El Wardian and Hanuvil market samples, respectively.

The present study indicate that the psychrophilic bacterial counts of Nile tilapia collected from the different markets were higher than mesophilic bacterial count.

All Nile tilapia samples had high quality considering that the microbiological upper limit for fresh fish proposed by ICMSF (1986), IFST (1999) & E. O. S. Q. C. (2005) not exceed $10^6$ CFU/g flesh.

## Grey mullet collected from different markets

**Sensory evaluation**

Sensory evaluation of raw and steamed grey mullet collected from different local markets in Alexandria city are shown in Tables (5 and 6). The results show significant differences among the samples collected from the different markets. The overall acceptability ranged from 4.6 to 9.3 and from 4.8 to 9.1 for raw and steamed grey mullet collected from the different markets, respectively.

Samples taken from Gheat Elsaaeidy and Bakkous markets possessed higher overall acceptability scores for both raw and steamed samples. However, the lower overall acceptability was recorded in Hanuvil samples.

The overall sensory scores less than 5 points mean that grey mullet samples are organoleptically rejected (Barile *et al*., 1985). According to the overall sensory scores (Tables 5 and 6), the samples collected from Shedia, Zine Elabidine, Alqsy, Gheat Elsaaeidy and Bakkous, markets had a higher quality grade, as well as acceptable grade was observed in samples collected from El Maydan, El Maamoura, Asafra, Zananiri, Derbala , Dekhela, El Wardian, Bab Omar pasha and El Amreya markets). On the other hand, unacceptable grade was noted in Hanuvil market samples.

**TVB-N of grey mullet**

Table (7) shows the values of TVB-N of grey mullet collected from different local markets in Alexandria city. The results indicated that the TVB-N content of the market samples ranged from 7.79 to 24.52 mg N/100g flesh. It was found that the TVB-N value varied significantly ($P<0.05$) between the different market samples. A significantly ($P<0.05$) higher value of 24.52 mg N/100g flesh was detected in TVB-N for Hanuvil market samples comparing with the other different samples. These increment may be attributed to the breakdown of nitrogenous substances as a result of microbial activity and any autolytic enzymes found naturally in fish tissues (El-Shamery, 2010). On the other hand, Zananiri market samples showed the lowest TVB-N level. No significant difference was noted between Zananiri, Bakkous and Zine Elabidine samples with respect to their content of TVB-N.

From the results obtained in the present study, it can be shown a correlation between the results of TVB-N, TMA-N, pH and bacterial load. These results agreed with those reported by Fernandez *et al*. (2009) & Jinadasa (2014). They found that the increment in the amount of TVB-N is parallel with the increase in TMA during spoilage. Further, these results are in agreement with the results recorded by Yasmin *et al*. (2001), Özyurt *et al*. (2009), Liu *et al*. (2010). They reported that significant correlation coefficient was observed between TVB-N changes and changes in mesophilic aerobic bacterial count.

All TVB-N values in the different samples, are below the maximum value of 30 mg N/100g flesh specified by CEC (1995), Connell (1995), Huss (1995), Gökodlu *et al*. (1998), Lopez-Caballero *et al*. (2000), E. O. S. Q. C (2005), Muhammet & Sevim (2007) & Liu *et al*. (2010), which set

**Table 4: Mean values of TVB-N, TMA-N, pH and bacterial count of Nile tilapia samples**

| Market name | quality parameters | | | | |
|---|---|---|---|---|---|
| **Shedia** | **TVB-N (mg N /100g flesh)** | **TMA-N (mg N /100g flesh)** | **pH** | **Mesophilic aerobic bacterial count (CFU /g flesh)** | **Psychrophilic aerobic bacterial count (CFU** /g flesh)** |
| Gheat Elsaaeidy | 11.73$^{g}$±0.41* | 6.26$^{e}$±0.18 | 7.05$^{ghi}$±0.03 | 2.47 ×103$^{e}$±5.50 ×102 | 4.23 ×103$^{ef}$±7.50 ×102 |
| Zine Elabidine | 13.22$^{e}$±0.72 | 6.57$^{de}$±0.20 | 7.12$^{d}$±0.04 | 6.73 ×103$^{e}$±8.73 ×102 | 1.08 ×104$^{def}$± 2.79×103 |
| Bakkous | 10.57$^{h}$±0.56 | 5.69$^{f}$±0.30 | 7.03$^{ef}$±0.02 | 8.47 ×102$^{e}$±1.45 ×102 | 1.29 ×103$^{f}$±3.73 ×102 |
| Zananiri | 11.99$^{fg}$±0.62 | 6.33$^{e}$±0.21 | 7.07$^{efg}$±0.01 | 4.10 ×103$^{e}$±1.00 ×103 | 7.27 ×103$^{ef}$±8.08 ×102 |
| Alqsy | 17.55$^{c}$±0.16 | 7.16$^{bc}$±0.36 | 7.30$^{c}$±0.01 | 2.97 ×104$^{c}$±9.07 ×103 | 5.23 ×104$^{cde}$±8.62 ×103 |
| El Wardian | 10.39$^{h}$±0.41 | 5.67$^{f}$±0.30 | 7.02$^{hij}$±0.01 | 1.16 ×103$^{e}$±4.68 ×102 | 1.64 ×103$^{f}$±6.37 ×102 |
| Bab omar pasha | 10.30$^{h}$±0.36 | 5.44$^{fg}$±0.27 | 7.01$^{j}$±0.02 | 1.86 ×103$^{e}$±4.74 ×102 | 9.73 ×102$^{f}$±2.05 ×102 |
| El Maydan | 10.21$^{h}$±0.26 | 5.13$^{g}$±0.21 | 7.02$^{hij}$±0.01 | 1.58 ×103$^{e}$±5.68 ×102 | 3.03 ×103$^{ef}$±9.07 ×102 |
| El Maamoura | 11.46$^{g}$±0.56 | 6.21$^{e}$±0.42 | 7.05$^{ghi}$±0.03 | 3.37 ×103$^{e}$±9.29 ×102 | 9.33 ×103$^{def}$±9.86 ×102 |
| Asafra | 15.31$^{d}$±0.45 | 6.69$^{cde}$±0.41 | 7.28$^{c}$±0.05 | 1.56×104$^{d}$±3.400 ×103 | 5.88 ×104$^{cd}$± 1.64×104 |
| Derbala | 13.07$^{e}$±0.41 | 6.50$^{de}$±0.29 | 7.09$^{de}$±0.02 | 8.33 ×103$^{de}$±1.35 ×103 | 2.03 ×104$^{def}$± 4.18×103 |
| Hanuvil | 18.36$^{b}$±0.31 | 7.38$^{b}$±0.19 | 7.34$^{b}$±0.01 | 7.27 ×104$^{b}$±1.14 ×104 | 1.11 ×105$^{b}$±2.70 ×104 |
| Dekhela | 26.77$^{a}$±0.15 | 8.21$^{a}$±0.32 | 7.38$^{a}$±0.02 | 9.83 ×104$^{a}$±1.07 ×104 | 5.17 ×105$^{a}$±1.11 ×105 |
| El Amreya | 12.63$^{ef}$±0.54 | 6.55$^{de}$±0.39 | 7.07$^{efg}$±0.03 | 3.50 ×103$^{e}$±1.04 ×103 | 7.30 ×103$^{ef}$± 1.21×103 |
| L. S. D. | 17.28$^{c}$±0.31 | 6.92$^{bcd}$±0.21 | 7.28$^{c}$±0.05 | 2.53 ×104$^{c}$±7.61 ×103 | 7.20 ×104$^{bc}$± 1.20×104 |
| | 0.75 | 0.5 | 0.03 | 7.78 ×103 | 4.98×104 |

*Data as mean ± SD.

**CFU Colony forming unit.

Means in the same column sharing the same letters are not significantly different at P< 0.05 level.

**Table 5: Sensory evaluation* of raw grey mullet samples**

| Market name | Sensory quality parameters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Eye | Gills | Body surface | Odour | Texture | Flesh condition | Viscera | Belly wall | Overall acceptability |
| Shedia | 8.2$^{b}$±0.42** | 8.4$^{b}$±0.52 | 8.2$^{b}$±0.63 | 8.3$^{bc}$±0.67 | 8.4$^{b}$±0.52 | 8.2$^{b}$±0.42 | 8.2$^{b}$±0.63 | 8.3$^{b}$±0.48 | 8.3$^{bc}$±0.48 |
| Gheat Elsaaeidy | 9.2$^{a}$±0.63 | 9.3$^{a}$±0.48 | 9.1$^{a}$±0.88 | 9.3$^{a}$±0.79 | 9.2$^{a}$±0.79 | 9.2$^{a}$±0.79 | 9.3$^{a}$±0.67 | 9.4$^{a}$±0.70 | 9.3$^{a}$±0.82 |
| Zine Elabidine | 7.7$^{b}$±0.82 | 7.7$^{c}$±0.67 | 7.6$^{b}$±0.70 | 7.8$^{c}$±0.53 | 7.5$^{c}$±0.53 | 7.6$^{b}$±0.70 | 7.7$^{b}$±0.48 | 7.8$^{b}$±0.63 | 8.0$^{c}$±0.67 |
| Bakkous | 9.0$^{a}$±0.81 | 9.1$^{a}$±0.57 | 9.1$^{a}$±0.87 | 8.9$^{ab}$±0.88 | 9.1$^{a}$±0.88 | 9.1$^{a}$±0.87 | 9.2$^{a}$±0.63 | 9.2$^{a}$±0.79 | 8.9$^{ab}$±0.88 |
| Zananiri | 6.0$^{cd}$±0.95 | 6.1$^{def}$±0.74 | 5.9$^{de}$±0.74 | 5.9$^{def}$±0.82 | 6.0$^{de}$±0.82 | 5.7$^{d}$±0.67 | 6.0$^{de}$±0.86 | 5.9$^{de}$±0.74 | 6.0$^{ef}$±0.47 |
| Alqsy | 8.3$^{b}$±0.70 | 8.3$^{bc}$±0.95 | 7.6$^{b}$±0.57 | 8.0$^{c}$±0.79 | 7.8$^{bc}$±0.78 | 8.1$^{b}$±0.74 | 8.0$^{b}$±0.67 | 8.1$^{b}$±0.57 | 8.0$^{c}$±0.47 |
| El Wardian | 5.6$^{de}$±0.84 | 5.7$^{efgh}$±0.67 | 5.5$^{ef}$±0.71 | 5.7$^{efg}$±0.69 | 5.6$^{ef}$±0.70 | 5.7$^{d}$±0.67 | 5.6$^{ef}$±0.52 | 5.4$^{ef}$±0.84 | 5.9$^{f}$±0.88 |
| Bab omar pasha | 5.6$^{de}$±0.85 | 5.5$^{fghi}$±0.85 | 5.6$^{ef}$±0.70 | 5.5$^{fg}$±0.70 | 5.6$^{ef}$±0.69 | 5.7$^{d}$±0.82 | 5.7$^{ef}$±0.82 | 5.6$^{ef}$±0.84 | 5.7$^{f}$±0.82 |
| El Maydan | 6.5$^{c}$±0.85 | 6.3$^{de}$±0.82 | 6.7$^{c}$±0.82 | 6.3$^{de}$±0.95 | 6.6$^{d}$±1.08 | 6.5$^{c}$±0.85 | 6.7$^{c}$±0.82 | 6.7$^{c}$±0.95 | 6.8$^{d}$±0.92 |
| El Maamoura | 5.7$^{de}$±0.67 | 5.8$^{efg}$±0.79 | 5.7$^{ef}$±0.82 | 5.8$^{defg}$±0.79 | 5.6$^{ef}$±0.84 | 5.5$^{d}$±0.85 | 5.7$^{ef}$±0.80 | 5.6$^{ef}$±0.69 | 5.7$^{f}$±0.82 |
| Asafra | 6.5$^{c}$±0.85 | 6.5$^{d}$±0.85 | 6.5$^{cd}$±0.85 | 6.4$^{d}$±0.84 | 6.3$^{d}$±1.06 | 6.6$^{c}$±0.70 | 6.5$^{cd}$±0.71 | 6.5$^{cd}$±0.85 | 6.6$^{de}$±0.69 |
| Derbala | 5.4$^{de}$±0.69 | 5.1$^{hi}$±0.88 | 5.1$^{f}$±0.74 | 5.2$^{g}$±0.79 | 5.0$^{f}$±0.67 | 5.1$^{de}$±0.88 | 5.1$^{f}$±0.88 | 5.1$^{f}$±0.88 | 5.5$^{f}$±0.70 |
| Hanuvil | 4.5$^{f}$±0.53 | 4.3$^{j}$±0.48 | 4.4$^{g}$±0.69 | 4.3$^{h}$±0.82 | 4.2$^{g}$±0.63 | 4.5$^{e}$±0.53 | 4.2$^{g}$±1.03 | 4.2$^{g}$±0.63 | 4.6$^{g}$±0.84 |
| Dekhela | 5.3$^{e}$±0.82 | 5.4$^{ghi}$±0.70 | 5.1$^{f}$±0.57 | 5.2$^{g}$±0.63 | 5.1$^{f}$±0.57 | 5.2$^{d}$±0.92 | 5.2$^{f}$±0.79 | 5.3$^{ef}$±0.67 | 5.4$^{f}$±0.70 |
| El Amreya | 5.3$^{e}$±0.67 | 5.0$^{i}$±0.82 | 5.1$^{f}$±0.56 | 5.3$^{fg}$±0.67 | 5.2$^{f}$±0.63 | 5.3$^{e}$±0.67 | 5.3$^{f}$±0.82 | 5.1$^{f}$±0.74 | 5.4$^{f}$±0.70 |
| L. S. D. | 0.67 | 0.65 | 0.68 | 0.67 | 0.68 | 0.67 | 0.67 | 0.65 | 0.64 |

*High grade: Overall sensory scores between 10 and 8.
Acceptable grade: Overall sensory scores less than 8 and more than 5.
Unacceptable grade: Overall sensory scores 5 or less.
**Data as mean ± SD.
Means in the same column sharing the same letters are not significantly different at P< 0.05 level.

**Table 6: Sensory evaluation* of steamed grey mullet samples**

| Market name | Sensory quality parameters | | | |
|---|---|---|---|---|
| | Odour | Texture | Taste | Overall acceptability |
| Shedia | 8.4$^{b}$±0.52** | 8.1$^{bc}$±0.74 | 8.6$^{c}$±0.52 | 8.5$^{ab}$±0.71 |
| Gheat Elsaaeidy | 9.2$^{a}$±0.63 | 9.0$^{a}$±0.94 | 9.3$^{a}$±0.48 | 9.1$^{a}$±0.88 |
| Zine Elabidine | 8.3$^{b}$±0.48 | 7.9$^{c}$±0.57 | 8.2$^{c}$±0.63 | 8.2$^{b}$±0.42 |
| Bakkous | 9.2$^{a}$±0.79 | 8.7$^{ab}$±1.06 | 9.2$^{ab}$±0.79 | 9.1$^{a}$±0.74 |
| Zananiri | 6.2$^{cd}$±0.78 | 5.9$^{de}$±0.73 | 6.1$^{de}$±0.74 | 6.4$^{cde}$±0.70 |
| Alqsy | 8.6$^{ab}$±0.67 | 8.2$^{bc}$±0.63 | 8.7$^{bc}$±0.67 | 8.5$^{ab}$±0.85 |
| El Wardian | 5.5$^{e}$±0.85 | 5.3$^{ef}$±0.95 | 5.6$^{efg}$±0.70 | 5.8$^{ef}$±0.92 |
| Bab omar pasha | 5.5$^{e}$±0.85 | 5.4$^{ef}$±0.97 | 5.4$^{fg}$±0.69 | 5.9$^{def}$±0.73 |
| El Maydan | 6.6$^{c}$±0.84 | 6.2$^{d}$±0.63 | 6.5$^{d}$±0.63 | 6.7$^{c}$±0.82 |
| El Maamoura | 5.6$^{de}$±0.84 | 5.5$^{ef}$±0.85 | 5.6$^{efg}$±0.85 | 5.8$^{ef}$±0.79 |
| Asafra | 6.2$^{cd}$±0.63 | 5.7$^{de}$±0.67 | 5.9$^{ef}$±0.94 | 6.5$^{cd}$±0.53 |
| Derbala | 5.1$^{e}$±0.99 | 5.0$^{fg}$±0.94 | 5.5$^{fg}$±0.53 | 5.6$^{f}$±0.70 |
| Hanuvil | 4.3$^{f}$±0.48 | 4.5$^{g}$±0.53 | 4.4$^{h}$±0.48 | 4.8$^{g}$±0.52 |
| Dekhela | 5.4$^{e}$±0.52 | 5.3$^{ef}$±0.48 | 5.3$^{g}$±0.67 | 5.6$^{f}$±0.67 |
| El Amreya | 5.3$^{e}$±0.67 | 5.4$^{ef}$±0.52 | 5.5$^{fg}$±0.52 | 5.7$^{f}$±0.89 |
| L. S. D. | 0.62 | 0.68 | 0.59 | 0.64 |

*High grade: Overall sensory scores between 10 and 8.
Acceptable grade: Overall sensory scores less than 8 and more than 5.
Unacceptable grade: Overall sensory scores 5 or less.
**Data as mean ± SD.
Means in the same column sharing the same letters are not significantly different at P<0.05 level.

TVB-N values of 30-35 mg N/100g flesh regarded as the limit of acceptability.

**The TMA-N of grey mullet**

The data presented in Table (7) show the TMA-N values of grey mullet collected from different local markets in Alexandria city. The results indicated that the TMA-N content of market samples ranged from 4.90 to 7.69 mg N/100g flesh. It was found that the TMA-N value varied significantly ($P$<0.05) between the different market samples.

Hanuvil market samples followed by El Amreya samples showed the highest value of TMA-N, with no significant difference between them, while samples collected from Zananiri market followed by Bakkous had the lowest level of TMA-N with no significant differences observed between them.

The TMA-N values of grey mullet collected from the different local markets were within the recommended standard limits for acceptability proposed by Huss (1978), AOAC (1984), FAO (1986), Ruiz-Capillas & Moral (2001) and Fathia *et al*. (2013).

**The pH values of grey mullet**

The data in Table (7) show the pH values of grey mullet collected from different local markets in Alexandria city. It was found that the pH value ranged from 6.74 to 7.13.

Hanuvil samples followed by El Amreya samples were recorded to have the highest value of pH with no significant difference between them. On the other hand, Bakkous samples followed by Zananiri samples showed the lowest value of pH with no significant difference between them.

The post mortem acceptable pH is usually 6.8-7.0 (Zang & Deng, 2012). After death of the fish, the glycogen present in the tissues gets oxidized to lactic acid and the creatine phosphate in the muscle breaks down releasing phosphoric acid (Huss,

**Table 7: Mean values* of TVB-N, TMA-N, pH and bacterial count of grey mullet samples**

| Market name | quality parameters | | | | |
|---|---|---|---|---|---|
| | TVB-N (mg N /100g flesh) | TMA-N (mg N /100g flesh) | pH | Mesophilic aerobic bacterial count (CFU / g flesh)** | Psychrophilic aerobic bacterial count (CFU** /g flesh) |
| Shedia | $9.02^{hi}\pm0.38$* | $5.83^{def}\pm0.76$ | $6.85^{h}\pm0.02$ | $1.79\times10^{3d}\pm5.58\times10^{2}$ | $5.63\times10^{3e}\pm1.35\times103$ |
| Gheat Elsaaeidy | $9.85^{gf}\pm0.16$ | $5.98^{de}\pm0.22$ | $6.96^{fg}\pm0.03$ | $2.02\times10^{3d}\pm2.30\times10^{2}$ | $1.72\times10^{4e}\pm2.80\times103$ |
| Zine Elabidine | $8.86^{i}\pm0.27$ | $5.56^{ef}\pm0.18$ | $6.83^{h}\pm0.05$ | $5.07\times10^{3d}\pm1.16\times10^{3}$ | $3.47\times10^{4de}\pm6.11\times103$ |
| Bakkous | $8.24^{j}\pm0.15$ | $5.33^{fg}\pm0.37$ | $6.77^{i}\pm0.01$ | $2.16\times10^{3d}\pm4.67\times10^{2}$ | $8.20\times103^{e}\pm9.16\times102$ |
| Zananiri | $7.79^{j}\pm0.27$ | $4.90^{g}\pm0.21$ | $6.74^{i}\pm0.01$ | $1.29\times10^{3d}\pm5.12\times10^{2}$ | $2.61\times10^{3e}\pm6.28\times102$ |
| Alqsy | $9.49^{gh}\pm0.41$ | $5.97^{de}\pm0.20$ | $6.92^{g}\pm0.02$ | $5.83\times10^{3d}\pm1.61\times10^{3}$ | $4.30\times10^{3e}\pm9.64\times102$ |
| El Wardian | $16.57^{c}\pm0.40$ | $7.16^{ab}\pm0.35$ | $7.09^{b}\pm0.01$ | $5.13\times10^{4bc}\pm9.61\times10^{3}$ | $1.34\times10^{5c}\pm2.15\times104$ |
| Bab omar pasha | $16.03^{c}\pm0.41$ | $6.92^{b}\pm0.54$ | $7.08^{bc}\pm0.01$ | $5.40\times10^{4bc}\pm1.24\times10^{4}$ | $1.37\times10^{5c}\pm2.40\times104$ |
| El Maydan | $10.39^{f}\pm0.15$ | $6.09^{de}\pm0.36$ | $6.97^{ef}\pm0.03$ | $6.97\times10^{3d}\pm1.25\times10^{3}$ | $5.27\times10^{4de}\pm6.66\times103$ |
| El Maamoura | $13.97^{d}\pm0.71$ | $6.80^{bc}\pm0.36$ | $7.04^{cd}\pm0.02$ | $2.20\times10^{4cd}\pm5.32\times10^{3}$ | $1.53\times10^{5c}\pm3.04\times104$ |
| Asafra | $11.73^{e}\pm0.31$ | $6.21^{d}\pm0.75$ | $7.01^{de}\pm0.02$ | $7.40\times10^{3d}\pm1.25\times10^{3}$ | $7.63\times10^{4d}\pm1.40\times104$ |
| Derbala | $16.03^{c}\pm0.16$ | $6.92^{b}\pm0.55$ | $7.06^{bcd}\pm0.03$ | $3.97\times10^{4bcd}\pm7.40\times10^{3}$ | $1.70\times10^{5c}\pm2.95\times104$ |
| Hanuvil | $24.52^{a}\pm0.06$ | $7.69^{a}\pm0.17$ | $7.18^{a}\pm0.02$ | $2.70\times10^{5a}\pm8.89\times10^{4}$ | $5.37\times10^{5a}\pm6.03\times104$ |
| Dekhela | $13.88^{d}\pm0.41$ | $6.24^{cd}\pm0.18$ | $7.01^{de}\pm0.07$ | $2.33\times10^{4cd}\pm8.44\times10^{3}$ | $2.27\times10^{5b}\pm8.19\times104$ |
| El Amreya | $19.79^{b}\pm0.31$ | $7.30^{ab}\pm0.19$ | $7.13^{a}\pm0.01$ | $7.37\times10^{4b}\pm1.10\times10^{4}$ | $2.37\times10^{5b}\pm6.99\times104$ |
| L. S. D. | 0.58 | 0.57 | 0.04 | $4.01\times10^{4}$ | $5.30\times10^{4}$ |

*Data as mean ± SD.
**CFU Colony forming unit.
Means in the same column sharing the same letters are not significantly different at $P< 0.05$ level.

1995). A release of both lactic acid and phosphoric acid triggers rapid change in pH of tissue fluids (MANAGE, 2008).

The pH values of grey mullet collected from the different local markets were correlated well with the results of TVB-N, TMA-N and bacterial load.

**Bacterial count of grey mullet**

The data presented in Table (7) show the bacterial count of grey mullet collected from different local markets in Alexandria city. The results indicated that the significant differences ($P$<0.05) were observed between the samples collected from the different markets for both mesophilic and psychrophilic bacterial count.

The mesophilic bacterial count ranged from $1.29x10^3$ CFU/g flesh to $2.70 x10^5$ CFU/g flesh for Zananiri and Hanuvil market samples, respectively. The psychrophilic bacterial count ranged from $2.61x10^3$CFU/g flesh to $5.37x10^5$ CFU/g flesh for Zananiri and Hanuvil market samples, respectively. Variation in the initial bacterial load could be ascribed to the microbial load of the waters in which they live (Huss, 1988). The eventual increase observed in mean total plate count could be due to multiplication of organisms favored at the storage condition (Ibrahim & El -Sherif, 2008).

The present study indicated that the psychrophilic bacterial count of grey mullet collected from the different markets were higher than mesophilic bacterial count.

The levels of mesophilic and psychrophilic aerobic bacterial count of grey mullet collected from the different local markets, agreed greatly with the recommendations set by ICMSF (1986), IFST (1999) and E. O. S. Q. (2005) which claimed that the maximum bacterial limit for fresh fish never exceeds the $10^6$ CFU/g flesh.

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# تقييم جودة أسماك البلطى النيلى والبورى التى تم جمعها من أسواق مختلفة بمدينة الإسكندرية - مصر

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الهدف من هذه الدراسة هو تقييم جودة أسماك البلطى والبورى التى تم جمعها من أسواق مختلفة بمدينة الإسكندرية –مصر. وفقاً لدرجات التقييم الحسى يمكن تقسيم جودة أسماك البلطى التى تم الحصول عليها من أسواق مختلفة إلى ثلاث درجات من الجودة على النحو التالى : الأسماك ذات الجودة العالية (درجات مابين ٨–١٠)، والأسماك المقبولة (درجات مابين ٥– ٧,٩) ، والأسماك البلطى غير المقبولة (درجات أقل من ٥) وهى العينات التى تم الحصول عليها من سوق الهانوفيل.

أوضحت النتائج ان كل قيم القواعد النيتروجينية الكلية المتطايرة بالنسبة لكل من البلطى والبورى أقل من الحدود المسموح بها تبعاً للمواصفات القياسية المصرية.

أوضحت النتائج أن كل قيم مركب ثلاثى ميثيل الأمين بالنسبة لكل من البلطى والبورى كانت أقل من الحدود المسموح بها.

وتراوحت قيم pH لعينات البلطى التى تم الحصول عليها من الأسواق المختلفة من ٧،٠١ إلى ٧،٣٨ وبينت النتائج وجود إختلافات معنوية بين الأسواق المختلفة. بالإضافة إلى ذلك سجلت العينات التى تم الحصول عليها من سوق الهانوفيل أعلى قيمة pH بينما سجلت العينات التى تم الحصول عليها من سوق الورديان أقل قيمة pH.

تراوحت قيم pH لعينات البورى التى من ٦,٧٤ إلى ٧,١٨ . وسجلت العينات التى تم الحصول عليها من سوق الهانوفيل متبوعاً بالعينات التى تم الحصول عليها من سوق العامرية أعلى قيمة pH مع عدم وجود فروق معنوية بينهم بينما سجلت العينات التى تم الحصول عليها من سوق باكوس متبوعاً بالعينات التى تم الحصول عليها من سوق زنانيرى أقل قيمة pH مع عدم وجود فروق معنوية بينهمت.

وقد تبين من هذه الدراسة أن عد البكتيريا المحبة للحرارة المنخفضة لأسماك البلطى والبورى التى تم الحصول عليها من الأسواق المختلفة كانت أعلى من عد البكتيريا المحبة للحرارة المتوسطة. كما أن قيمة عد البكتيريا المحبة للحرارة المتوسطة و المنخفضة بالنسبة لكل من البلطى والبورى كانت أقل من الحدود الموصى بها.