QUANTITY ASSESSMENT OF WHOLE AND GUTTED INDO PACIFIC KING MACKEREL STORED IN FREEZER

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ABSTRACT
The quality and shelf life of whole and gutted Indo Pacific king mackerel stored in freezer were studied. The changes in the fish were investigated by sensory assessments, chemical analyses. The sensory scores of uneviscerated and gutted Indo Pacific king mackerel stored in -10 °C were 20 days. pH value of Indo Pacific king mackerel fillet was increased (P < 0.05) with storage time, indicating that alkaline compounds were accumulated through autolytic activities or microbial metabolism. Sensory properties of samples were evaluated according to hedonic scale. General appearance, odor, color and texture were used as criteria for acceptability. The shelf life of Indo Pacific king mackerel fillets stored at-10°C ranged 8 - 18 days considering fish freshness.

Key words: Quality assessment; Pacific king mackerel; Shelf life; Sensory changes, pH. Stored in freeze.

INTRODUCTION
Marine species provide high content of important constituents for the human diet such as nutritional and digestible proteins, lipid-soluble vitamins (A and D), microelements (I, F, Ca, Cu, Zn, Fe, Se and others) and ω-3 polyunsaturated fatty acids (Simopoulos, 1997). However, such species led to highly perishable food products whose freshness and quality rapidly decline post-mortem. Thus, different damage pathways are known to develop after death that can be summarized as endogenous enzyme activity, microbiological development, non-enzymatic lipid oxidation and browning, and enzymatic browning (Pigott and Tucker, 1990). The relative incidence of each damage mechanism will depend on the kind of technological process applied and on the kind of the marine species involved.

The nutritional composition of fish varies greatly from one species and individual to another, depending on age, feed intake, sex and sexual changes connected with spawning, the environment and season (Silva and Chamul, 2000). Processors have direct interest in the chemical composition of fish in order to know the nature of the raw material before chilling, freezing, smoking or canning can be correctly applied. The quality of fresh fish is a major concern to the fish industry and consumers. Like marine fish, fresh water fish are perishable commodities. Deterioration in the quality of fish occurs due to the effect of a variety of biochemical and microbial mechanisms. However, the rate of loss of quality depends directly on the nature of the fish species and on the handling and storage conditions (Olafsdottir et al, 1997). Once the fish are caught, on-board storage conditions exert a strong effect on the quality of manufactured fish products and ac-
Accordingly on their commercial values. Storage time and conditions have great impact on the quality of fish and fish products and the storage stability depends on the composition of the fish (Ashie et al., 1996). The rate of deterioration of fish is highly temperature dependent and can be inhibited by the use of low storage temperature (Kraus, 1992). Icing reduces temperature to about 0°C which lowers the growth of spoilage and pathogenic micro-organisms and hence their spoilage rate. Ice has a large cooling capacity, and therefore, a comparatively small amount of ice will be needed to cool one Kilogramme of fish. The reason why more ice is needed in practice is mainly because ice melting tends to compensate for thermal losses (Huss, 1995).

Fish is one of foods characterized by poor shelf life (pH > 5.2; aw > 0.95), and they must therefore be stored at chill temperatures (-1 to +2 °C). Even under such conditions, shelf life of unpacked fish is very short (3 to 5 days), and is limited to a period when the products still meet sensory requirements on freshness categories laid down by the Council Regulation (EC) 2406/1996 and chemical requirements laid down by the Commission Regulation (EC) No. 2074/2005. In muscle tissue of fresh chilled fish (-1 to +2 °C), autolytic and proteolytic changes catalyzed by microbial enzymes take place during storage. Proteins are being gradually cleaved into peptides, amino acids, ammonia and some other low molecular N-substances. Toxic biogenic amines (histamine, tyramine) may be produced by activities of some microorganisms. Shelf life of fat fish is limited by lipid decomposition (Özogul et al., 2005). Oxidation of the fat component may give rise to some mutagens, promoters and carcinogens (hydroperoxides, endoperoxides and epoxides of fatty acids and cholesterol, aldehydes, alkoxys and hydroperoxy radicals). Sensory quality of products in storage is further impaired by colouring substance oxidation that takes place in fish muscle tissue.

Fish is highly perishable, due to its high water activity (aw) and protein content, neutral pH and presence of autolytic enzymes which cause fish spoilage. The rate of fish spoilage is affected by species, fat content, fishing and slaughter method, hygiene manipulation, postmortem handling and many other factors (Huss, 1995). Postmortem fish undergoes four stages as rigor mortis, dissolution of rigor mortis, autolysis and bacterial spoilage. The initial loss of freshness is caused by endogenously autolytic enzymes in muscle and the subsequent spoilage is usually due to microbial activities, especially for the rapid proliferation of specific spoilage organisms (SSO) (Huss, 1995). Interaction between microbial metabolism and physiochemical reactions accelerate fish quality deterioration as amines formation, lipid oxidation, nucleotide and protein degradation, contributes to off-odors, off-flavors and texture softening (Ozogul et al., 2006; Alasalvar et al., 2001; Hernandez et al., 2009). Varieties of quality attributes have been used to assess fish freshness in many cold water fish species as sea bream, sea bass, sardine and European eel (Alasalvar et al., 2001; Alasalvar et al., 2002; Ozogul et al., 2004; Ozogul et al., 2006; Hernandez et al., 2009). However, few researches were reported on quality assessment for tropical freshwater fish species (Chytiri et al., 2004).

**MATERIALS AND METHODS**

**Raw material sampling**

Three kg packaged Fresh Indo Pacific king mackerel were purchased from fishermen at about 30 km from Behbahan, town, Iran, between April and August, 2010. Sampling area was cited in southern Iran so called Dilm Bander town, inside Iran Persian Gulf. The time interval between harvesting and arrival of the fish at the landing sites was about 3-4 hours and they were iced on purchase by layering with flaked ice. The control samples were iced immediately after being taken off the nets at the fishing ground by the fishermen according to our instructions. The iced Indo Pacific king mackerel were transported to a chill store and stored at a temperature of 0-2°C overnight before being transported within 4-5 hours to the Food Chemistry Laboratory at Behbahan University. The mussels were put into insulated sterile plastic boxes without ice or water.
The plastic boxes were stored in a refrigerator (4 ± 1°C) and samples were analyzed every day to determine the shelf-life. After sensory analysis, samples were homogenized and subjected to determination of pH by digital pH meter in the Lab. of Behbahan University in Iran. This work was done as free research project.

**Sensory analyses**

Five judges assessed the sensory properties of samples and a hedonic scale (Table 1) was used. General appearance, odor, color and texture were used as criteria for acceptability. The mean values of these criteria from all panelists were calculated and the mus-sels were classified according to the following correspondence between points and quality bands: 9 = E = 8; 8 > A = 6; 6 > B = 4; 4 = C. (Paulus, et al., 1969).

**Chemical analyses**

**pH**

pH was determined at room temperature on homogenates of mussel in distilled water (1:10, w/w). pH was measured using a microprocessor-controlled pH meter (Model WTW 537; WTW, Weilheim, Germany). (Manthey, et al., 1988).

**RESULTS AND DISCUSSION**

**Sensory evaluation**

The decrease of sensory scores was highly correlated with storage time (Figure 1), indicating quality deterioration. Fresh sea weedy odor, bright red, firm texture and no off-odors were observed in fresh raw samples. Raw fillets maintained good quality within 7-day storage and were acceptable up to day 13. After that, the quality deterioration was ob-

*Fig. 1: Sensory acceptability of Indo Pacific king mackerel during storage at -10°C.*
served as off odors, opaque mucus, discoloration and texture softening, which limited overall acceptability of raw fillets. Characteristic flavor and sweetness were strong before 6 day, decreased gradually in intensity and became flavorless on day 7. On day 16, slight off-flavor was rejected by the panel and then no further taste test was performed. The inspection of raw fillet was still performed until the end of storage to expound the characters of fillet spoilage. The shelf life of Indo Pacific king mackerel fillets stored at -10°C ranged 8 - 18 days considering fish freshness.

Changes of pH

PH value of Indo Pacific king mackerel fillet was increased (P < 0.05) with storage time (Figure 2), indicating that alkaline compounds were accumulated through autolytic activities or microbial metabolism (Pons-Sanchez-Cascado et al., 2006). Texture differences occurred due to differences in protein structure as muscle fiber diameter and chemical contents and measurement methods (Jonsson, et al., 2001). Haard (1992) suggested that texture of fish flesh was influenced by many factors including postmortem pH decline, proteolysis, fat content, composition and its distribution in the fish muscle. Water holding capability (WHC) was at first decreased and then increased throughout the storage. This was not consistent with previous reports that showed hardness reduction, springiness increase and fluctuant WHC in ice-stored meager fillets for 18 days (Hernandez, et al., 2009). However, hardness reduction tested by instrument agreed well with texture softening of raw fillets judged by sensory evaluation. The WHC of muscle was regarded as an essential quality parameter and great influence to muscle texture concerned by both industry and the consumers (Ofstad, et al., 1993; Olsson, et al., 2003). WHC reflected the free or mobilizable water as a textural pa-

![Fig. 2: Changes in pH of Indo Pacific king mackerel during storage at -10°C.](image)

Texture analysis

Texture softening was mainly influenced by the autolysis and denaturation of muscle protein during the chilled and frozen storage (Tsuchiya, et al., 1992; Benjakul, et al., 1997). Texture differences occurred due to differences in protein structure as muscle fiber diameter and chemical contents and measurement methods (Jonsson, et al., 2001). Haard (1992) suggested that texture of fish flesh was influenced by many factors including postmortem pH decline, proteolysis, fat content, composition and its distribution in the fish muscle. Water holding capability (WHC) was at first decreased and then increased throughout the storage. This was not consistent with previous reports that showed hardness reduction, springiness increase and fluctuant WHC in ice-stored meager fillets for 18 days (Hernandez, et al., 2009). However, hardness reduction tested by instrument agreed well with texture softening of raw fillets judged by sensory evaluation. The WHC of muscle was regarded as an essential quality parameter and great influence to muscle texture concerned by both industry and the consumers (Ofstad, et al., 1993; Olsson, et al., 2003). WHC reflected the free or mobilizable water as a textural pa-
rameter in muscle and affected sensory perception of juiciness of the fillet (Jonsson, et al., 2001). The WHC improvement could be affected by bacterial growth and protein degradation, the disintegration of collagen fibrils and cleavage of cross-links was mainly due to bacterial proteinases, contributing to texture softening (Olsson, et al., 2003).

**Statistical Analysis**

All data were expressed as means ± standard deviation of (3n) measurements.

**CONCLUSION**

In the present study a shelf-life of 20 days was recorded for freezer storage Indo Pacific king mackerel fillets, compared with a shelf-life of 9-10 days for the nonstoraged the fish based on sensory and chemical evaluation.

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