

# Changes in Sensory Evaluation Scores of Smoked Catfish Fillets during Refrigeration Storage

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**Received Date:** 12<sup>th</sup> February 2019

**Accepted Date:** 01<sup>st</sup> March 2019

**Published Date:** 05<sup>th</sup> March 2019

**Citation:** Adel A. El-Lahamy, Khalil I. Khalil, Shaban A. El-Sherif and Awad A. Mahmud(2019) Changes in sensory evaluation scores of smoked catfish fillets during refrigeration storage. Enliven: J Diet Res Nutr 6 (1): 001.

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## Abstract

Changes in sensory evaluation scores of hot and cold smoked catfish (*Clarias gariepinus*) fillets during refrigeration storage for 40 days were determined. The result indicated that score values for color of hot and cold smoked fillets slightly decreased and color changes were more observed at the late stages of storage. As it was mentioned for color changes, taste, odour and texture changes showed the same trend during storage period. The results indicated that hot and cold smoked Catfish fillets retained their good acceptances by panellists for about 30-35 days of refrigerated storage since their overall acceptability score values were  $7.4 \pm 0.346$  and  $7.6 \pm 0.288$  respectively. This is the outcome of maintaining all the sensory quality attributes without undesirable changes during these periods of refrigerated storage.

**Abbreviations:** Catfish fillets; Refrigeration storage; Hot and cold smoking

## Introduction

Fish and fishery products have long been recognized as healthy foods with excellent nutritional value, providing high-quality protein, minerals, vitamins, essential fatty acids and trace elements. Fish is widely consumed in many parts of the world by humans due to its high content of good protein that characterizes by an excellent amino acid composition and easily digestibility [1]. Since fresh fish spoil easily, they need to be processed and preserved. Preservation provides a long shelf-life for fish and fish products. The main purpose of both of these is to prevent spoilage, especially by microorganisms. Several preservation methods have been developed, some of them providing a longer shelf-life than others. Smoking is a method that utilizes smoke to introduce flavour, taste, and preservative compounds into the food. It is one of the oldest methods that have been used to process and preserve fish [2]. Fish smoking is particularly relevant in the artisanal fisheries sector in that it prolongs the shelf - life of the fish, enhances flavour and increases utilization of the fish in addition to reducing the waste as well as increasing protein availability [3]. Smoking has become a mean of offering diversified, high value added products as an additional marketing option for certain fish species where fresh consumption becomes limited [4]. Smoking is not an absolute preserving method. For this reason, the quality of raw material, the concentration of salt, water activity of the fish, heat

through the smoking process, the quantity of smoke, the way of packaging, hygienic circumstances and heat of storage have the most important effects to reduce the risk of deterioration [5]. The choice of a preservation method depends on the product, properties of the product, availability of energy, the storage facilities, and the costs of the method. It is sometimes necessary to combine methods [6]. Fish is generally distributed live, fresh, chilled, frozen, heat-treated, fermented, dried smoked, salted, pickled, boiled, fried, freeze-dried, minced, powdered or canned, or as a combination of two or more of these forms [7]. During fish spoilage, there is a breakdown of various components and the formation of new compounds. These new compounds are responsible for the changes in odour, flavour and texture of the fish meat [8]. The quality changes can easily be noticed and consist of changes in colour, odour or smell, taste, appearance and texture, and are therefore called sensory changes. There is a sensorial or product associated alteration that can be contributed by proteolysis enzymes [9]. Microbial growth and metabolism is a major cause of fish spoilage, which produces amines, biogenic amines, organic acids, sulphides, alcohols, aldehydes and ketones, with unpleasant and unacceptable off-flavours [8]. The first sensory changes of fish during storage are concerned with appearance and texture. Sensory properties such as appearance, odour, taste and texture of

fish are the most important factors for consumer choice. Therefore the aim of current study was to follow up the changes which occur in sensory evaluation of hot and cold smoked catfish fillets during refrigeration storage period.

## Materials and Methods

### Fish Sample

Fresh Catfish (*Clarias gariepinus*) samples were obtained from Wadi El-Rayan Lake, Fayoum Governorate, Egypt, during August 2015. Averages of weight and length ranged between 1.8-2.3 kg and 56-60 cm, respectively. The fish samples were transported in ice-box to the laboratory of Fish Processing Technology, Shakshouk Station for Fish Research, National Institute of Oceanography and Fisheries (NIOF), Fayoum Governorate, Egypt. Fish samples were beheaded, gutted and washed gently with tap water then skinned and filleted manually. The edible part (fillets) of Catfish was about 48%.

### Ingredients

The different ingredients included table salt was obtained from the local market. Sawdust was obtained from carpentry workshop.

### Smoking Methods

Smoked Catfish fillets were produced by following the traditional methods of cold and hot smoking using smoking oven at Shakshouk Fish Research Station (NIOF). The conditions of smoking are described in (Table 1) as reported by [9].

Smoking Parameters	Cold smoking	Hot smoking
Brining (%NaCl)	10%	10%
Brining period (h)	1	1
Air drying period (h)	3	3
Temperature (°C)	30 - 40	50 - 90
Smoking period (h)	11-12	5 - 6
The source of fuel	sawdust	sawdust

Table 1: Conditions of Smoking

Hot and cold smoked Catfish fillets samples were packed in polyethylene bags and stored in the refrigerator at  $4 \pm 1^\circ\text{C}$  for 40 days. Samples were withdrawn periodically at intervals of 5 days during storage for sensory evaluation.

### Sensory Evaluation

Smoked Catfish fillets and cooked Mullet fish samples were tested for color, odour, taste, texture and overall acceptability immediately after processing and periodically during refrigeration and frozen storage by ten panellists chosen from the staff members of the shakshouk fish research station. Fish products were evaluated according to the method of [10] using the following numerical system:

Excellent	8.6 – 10	Very good	7.6 – 8.5
Good	6.6 – 7.5	Accepted	5.0 - 6.5
Poor	4 – 4.9	Very poor	0- 3.9

## Statistical Analysis

Data obtained were analyzed statistically using the least significant difference test (LSD) at ( $P \leq 0.05$ ) and Standard Error (Mean  $\pm$  SE) which calculated using SPSS 16.0 for windows (SPSS Inc., Chicago, USA).

## Results and Discussion

### Sensory Quality Attributes

Organoleptic properties of fishery products are correlated significantly with their chemical, physical and microbiological characteristics. Hot and cold smoked Catfish fillets were evaluated for their organoleptic characteristics at intervals of 5 days during refrigeration storage (at  $4.0 \pm 1\text{C}$ ) for 40 days to assess the storage stability of such products. The panelists were asked to evaluate the sensory properties of the product in terms of color, taste, odor, texture and overall acceptability. Data collected from the evaluation were statistically analyzed and the results obtained are tabulated in (Figures 1-5).

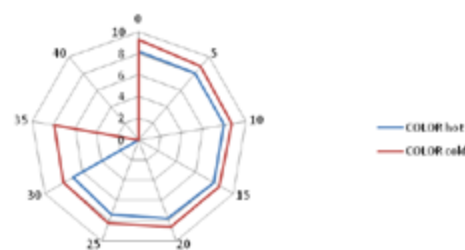


Figure 1: Changes in Color of Smoked Catfish Fillets during Refrigeration

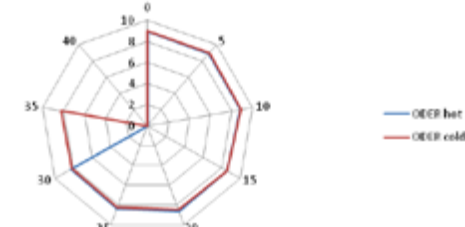


Figure 2: Changes in Odor of Smoked Catfish Fillets during Refrigeration Storage at  $4.0 \pm 1^\circ\text{C}$ .

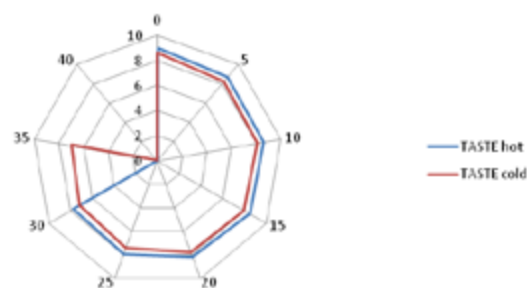
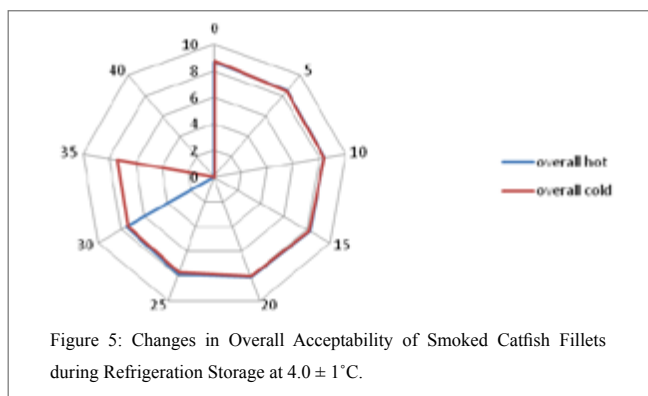
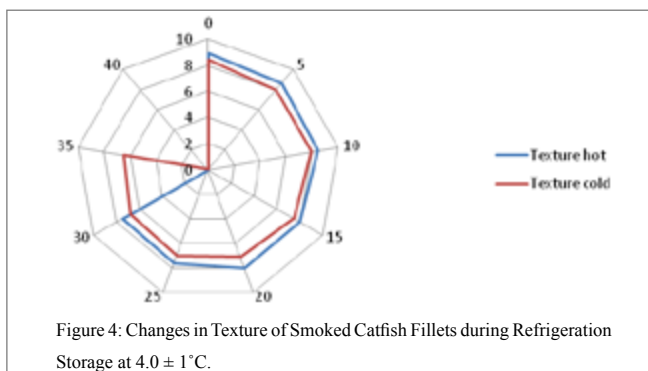


Figure 3: Changes in Taste of Smoked Catfish Fillets during Refrigeration Storage at  $4.0 \pm 1^\circ\text{C}$ .



### Color

Data given in (Figure 2) show the changes in color of hot and cold smoked Catfish fillets samples during refrigeration storage. Data showed that color of the smoked Catfish fillet samples was highly accepted by the panelists as indicated from the high values scored for cold smoked ( $9.3 \pm 0.346$ ) and hot smoked samples ( $8.2 \pm 0.173$ ). The result indicated that score values for color of hot and cold smoked fillets slightly decreased and color changes were more observed at the late stages of storage. Hot and cold smoked fillets maintained their good colors almost over the entire storage period. Color of hot and cold smoked fillets scored the values of  $7.0 \pm 0.144$  and  $7.9 \pm 0.230$  after storage periods of 30 and 35 days, respectively indicating the good quality of the samples. Beyond these storage times, the samples were rejected by the panelists due to development of microbial growth on the surface of smoked products after 35 and 40 day for hot and cold samples, respectively. Compared to the traditional hot smoking, cold smoking runs longer, has a higher yield and retains the original textural properties much better than the hot-smoked ones [11].

### Taste and Odor

In general, smoked fish products are characterized by their distinguished and popular taste and odor which are the most important sensorial characteristics that affect the popularity and acceptability of such products. Taste and odor of the hot and cold smoked Catfish fillets were evaluated during storage at  $4.0 \pm 1^\circ\text{C}$  and the results obtained are shown in (Figures 2, Figure 3). At zero time of storage, taste values of the hot and cold smoked Catfish fillets were as high as  $9.0 \pm 0.144$  and  $8.6 \pm 0.086$ , respectively while odor of the same samples scored values of  $8.9 \pm 0.028$  and  $9.0 \pm 0.115$ , respectively indicating the highly good taste and odor of the smoked products. Taste and odor properties of the smoked fish products are usually a result of the interpenetration of several factors particularly salting

treatment, smoke compounds that are generated during smoking process and the chemical reactions and changes that take place during Smoking.

As it was mentioned for color changes during storage of the evaluated smoked samples, taste and odor changes showed the same trend. The results indicated that score values for taste and odor of hot and cold smoked Catfish fillets slightly decreased as the storage period prolonged. Odor and taste of the hot and cold smoked Catfish fillets showed significant changes during refrigeration storage. The high values of taste of cold and hot smoked samples ( $9.0 \pm 0.144$  and  $8.6 \pm 0.086$ , respectively) slightly decreased to  $8.2 \pm 0.028$  and  $8.3 \pm 0.057$  after 35 and 30 days, respectively. Similar findings were recorded for the odor property in the same samples. It could be concluded that almost the hot and cold smoked Catfish fillets maintained their good qualities of taste and odor for about 30 – 35 days of storage.

### Texture

Data presented in (Figure 4) showed that texture of hot and cold smoked Catfish fillets scored the values of  $8.9 \pm 0.017$  and  $8.4 \pm 0.011$ , respectively before storage. Similarly to the observations noted with color, odor and taste, it was found that texture score values of hot and cold smoked Catfish fillets significantly ( $p < 0.05$ ) decreased during refrigeration storage. The results showed that initial scores values of texture of hot and cold smoked Catfish fillets gradually decreased down to  $7.5 \pm 0.092$  and  $6.5 \pm 0.057$  after 30 and 35 days, respectively. This observation might be attributed the loss in moisture content of smoked fillets during refrigeration storage.

### Overall Acceptability

According to the findings recorded for the sensory properties of color, taste, odor and texture of the cold and hot smoked Catfish fillets during storage, the overall acceptability of the samples showed the same trend. As shown in (Figure 5), the initial score values of the overall acceptability of hot and cold smoked Catfish samples were as high as  $8.7 \pm 0.057$  and  $8.8 \pm 0.115$ , respectively indicating the good qualities and high acceptance of the smoked products. During storage the overall acceptability slightly changed particularly at the later stages of storage. The results indicated that hot and cold smoked Catfish fillets retained their good acceptances by panelists for about 30-35 days of refrigerated storage since their score values were  $7.4 \pm 0.346$  and  $7.6 \pm 0.288$ , respectively. This is the outcome of maintaining all the sensory quality attributes without undesirable changes during these periods of refrigerated storage. Score values for color, odor, taste and texture (Figures 1- 4) indicated the high stability of these quality parameters of the hot and cold smoked Catfish fillets during refrigerated storage. Consequently, the hot and cold smoked Catfish fillets were liked by the panelists and they maintained the high acceptability during refrigerated storage for 35 and 40 days respectively.

### Conclusion

Score values for color, odour, taste and texture indicated the high stability of these quality parameters of the hot and cold smoked Catfish fillets during refrigerated storage. Consequently, the hot and cold smoked Catfish fillets were liked by the panellists and they maintained the high acceptability during refrigerated storage for 35 and 40 days respectively.

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