

## SENSORY, CHEMICAL AND MICROBIOLOGICAL EVALUATION OF SMOKED HERRING FISH

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### ABSTRACT

*Evaluation of sensory, chemical and microbiological status of smoked herring sold in supermarkets in Egypt was carried out. Twenty five random samples of smoked herring were taken and transferred directly to the laboratory under aseptic conditions with a minimum of delay. The samples were subjected to sensory, chemical and microbiological examinations. The obtained results revealed that 16 % of samples were rejected due to higher total bacterial count; 44% rejected for presence *S. aureus* count, 32 % rejected for presence of anaerobic count and 24 % rejected for presence of coliforms count when compared with the relevant Egyptian Standard, ES 288/2005 (EOS, 2005). The data also revealed that one can depend on smoking to minimize growth of spoilage and/or pathogenic microorganisms. The data also indicate that about 44% of the examined samples were rejected microbiologically (*S. aureus*), while about 16 % were rejected chemically (pH and TVN) and about 7 % were rejected by sensory evaluation (Macerated and much macerated). So, one cannot depend upon sensory and chemical tests alone for determination of hygienic quality of smoked fish. Recommendations to improve quality and safety of smoked herring fish were discussed.*

### INTRODUCTION

Smoking is one of the oldest methods of preservation. Long before, there were refrigerators and freezers; our fish ancestors learned to use a combination of salt and smoke to keep fish away from spoiling.

The objective of smoking of fish was to increase the shelf life of the raw materials. Random smoking procedures are designed to impact the desired sensory characteristics to fish uniformly and consistency from batch to another (Footitt and Lewis, 1999).

Smoked fishes are usually eaten as seasonal diet among Egyptian, particularly in the Easter Feast (Sham El-Nesseem). In the particular season emergency measures were taken every where

all over the country to prevent and to treat a possible infection due to the consumption of anomalous amount of fishes in that particular feast day. Moreover, controversy about this issue are usually held annually, just before and during this season, regarding the possible risks coming due to the consumption of salted and smoked fishes. Outbreaks are recorded every year due to poisoning, with some deaths, of admontish importance in this direction, and always the botulism and the staphylococcal intoxication were the cause.

The Egyptian Standard, ES 288/2005 (EOS, 2005) stated that smoked fish product is that fish which had been prepared (headed, eviscerated, filleted) and salted by Sodium chloride, and partially dried, then exposed to smoke, which produced by burning special type of wood or saw dust. The smoke must penetrate the meat tissue to give final product with special color, taste and odor. It is possible to avoid the use of the smoking process by adding smoke flavoring mixtures to the fish.

The organoleptic quality of smoked fish and fish products (cooked fishes) received the attention of some insiders in the EC community (Howgate et al., 1992). The early work made by Shewan et al. (1953), and that reported by Wheaton and Lawson (1985); Connell (1995) and Rulter (1995) enable rates of spoilage to be measured in sensory terms and to make more precise comparison as well as a multilingual guide to freshness grades.

Ideally, smoked fish should get its flavor and mahogany color from the smoke, but many cheaper smoked fish have smoke flavor as additives. Smoking process is considered as a sequel of curing, the result is dry, golden brown surface which is imperative, beside the wood smokes that are deposited on the fish products which inhibit the development of spoilage organisms and act as antioxidant. It is of prime interest to use the curing and smoking processes to increase the palatability of the product which will meet the consumer acceptance and/or preferences (Frothier et al., 1980).

The Egyptian Standard, ES 288/2005 (EOS, 2005) stated that the TVN should be less than 30 mg% and pH should be less than 6.8.

Health hazards related to consumption of contaminated fish and fish products with enteropathogens involved in food poisoning cases, such enteropathogenic bacteria include *Escherchia coli*, *Shigella* spp., *Bacillus cereus*, *Vibro parahaemolyticus*, *Clostridium perfringens*, *Salmonella* spp. and *Listeria monocytogenes*. Preventive steps were taken by such organization as FAO/WHO were outlined (Bykowski, 1998).

*Shigella* and also *Vibro parahaemolyticus* was found in sea foods in the US associated with fecal contamination and causing food born disease (Lipp and Rose, 1997).

Glamino and Segarra (1998) found that foodborne diseases and food poisoning usually arising from consumption of fish contaminated by *Clostridium perfringens*.

Buchmann et al. (1999) stated that despite a low incidence of botulism in the industrialized world, some cases occasionally occur in Germany after eating contaminated food. Because botulism is rarely seen, most physicians are unfamiliar with its early recognition and treatment. However, immediate intensive care treatment is important. The authors added that they reported the case of a previously 54-year old female who developed signs of botulism after eating vacuum-packed smoked fish and developed severe respiratory insufficiency with difficult carbon dioxide elimination in the days following.

Fell et al. (2000) reported an outbreak of *Salmonella* blockley infection following smoked eel consumption in Germany.

So, the present study was conducted to evaluate the sensory, chemical and microbiological conditions of smoked fish sold in retail market in Alexandria governorate.

### **MATERIAL AND METHODS**

Twenty five random samples of smoked herring were collected from some supermarkets in Egypt. The samples were taken and transferred directly to the laboratory under aseptic conditions with a minimum of delay. The samples were subjected to sensory, chemical, and microbiological examinations

**The methods of examination were carried out according to the following :**

- 1- Sensory examination was carried out according to **Connell (1990)**
- 2- Chemical examination includes:
  - 2.1- pH value was carried out according the technique recommended by **ISO (1979)**.
  - 2.2- TVN was done according the technique recommended by **FAO (1980)**.
- 3- Microbiological examination:
  - 3.1- Determination of total bacterial count was performed according to **ICMSF (1996)**.
  - 3.2- Determination of total Coliforms count was done using violet red bile agar according to **APHA (1985)**.
  - 3.3- Enumeration of presumptive *Escherichia coli* was carried out according to **ISO (1994)-11866**.
  - 3.4- Enumeration and identification of *Staphylococcus aureus* were performed according to

**ICMSF (1996).**

- 3.5- Detection and enumeration of *Listeria monocytogenes* was carried out according to **ISO (1995)-11290.**
- 3.6- Detection of *Salmonella* was carried out according to **ISO (1993)-6579.**
- 3.7- Determination of total Mold and yeast count was done according to **Balley and Scott (1998).**
- 3.8- Determination of total aerobic sporeforming count was performed according to **ICMSF (1996).**
- 3.9- Determination of total anaerobic sporeforming count was carried out according to **ICMSF (1996).**
- 3.10- Determination of *Vibrio parahaemolyticus* was carried out according to **APHA (1992).**
- 3.11- Enumeration of *Clostridium perfringens* was carried out according to **ISO (1985)-7937.**

**RESULTS AND DISCUSSION**

Table (1) revealed that the sensory examination of market smoked herring for skin condition indicate that 72 % of samples were with accepted Intact skin and 12 % were with unaccepted macerated skin while 4% were with much macerated skin (this maceration may be due to using imported frozen herring fish which could be macerated during splitting and thawing of fish blocks or physical damage during handling), while examination of marketed smoked herring for skin color indicate that 24 % of samples were with golden brown color and 76 % were with golden yellow color and no sample was recorded with dark brown or moldy growth (this indicate completed and good smoking processes), while examination of marketed smoked herring for consistency condition indicate that 76 % of samples were firm and 24 % were friable and this may be due to high fat % or beginning of deterioration and no samples were soft or dry, and also examination of marketed smoked herring for flesh odor condition indicate that 84 % of the samples were considered as smoked fishy odor and 4 % were musty odor and this may be due to beginning of deterioration, while examination of marketed smoked herring for flesh taste condition indicate that 84% of samples were with smoked fishy taste and 4 % were with salty taste(due to over use brine solution) and no sample was with bitter or musty taste.

Nearly similar results were obtained by **Daoud and Abd El-Azziz (1996)**, **Wafaa (1999)**, **Bassawrows et al. (2000)** and **El-Kewaley (2001)**.

The data reported in table (2) indicated that the minimum, maximum and mean values of pH

on smoked herring fish were 5.8, 7.2 and  $6.24 \pm 0.08$ , respectively (84 % accepted and 16 % were unaccepted pH Over 6.8), while the minimum, maximum and mean values of TVN on examined smoked herring fish were 18, 48 and  $25.99 \pm 1.68$ , respectively (84 % accepted % and 16 % were unaccepted) (TVN Over 35 mg%).

Nearly similar results were obtained by **Saber et al. (1992)**, **Daoud and Abd El-Azziz (1996)**, **Elmelbloom et al. (1996)** and **Vishwanath et al. (1998)**, while higher results were obtained by **El-Kewaley (2001)**.

The results recorded in table (3) revealed that the incidence of positive samples appeared as minimum, maximum and mean values of total bacterial count (CFU/ml) on smoked herring fish were 25(100%),  $2 \times 10^2$ ;  $1.2 \times 10^6$  and  $7.4 \times 10^4 \pm 4.8 \times 10^4$ , respectively; for *Staphylococcus aureus* count were 11 (44%); 0;  $6 \times 10^4$ , and  $9.1 \times 10^3 \pm 3.9 \times 10^3$ , respectively; for anaerobic count were 20 (80%), 0;  $9 \times 10^3$ , and  $7.1 \times 10^2 \pm 3.9 \times 10^2$ , respectively while for mold and yeast count were 21 (84%),  $0.5 \times 10^3$  and  $6.7 \times 10^2 \pm 2.3 \times 10^2$ , respectively and also for Coliforms count were 6 (24%), 0;  $3.5 \times 10^3$  and  $1.6 \times 10^2 \pm 1.4 \times 10^2$ , respectively finally for sporeforming count were 50 (100%),  $8 \times 10$ ;  $2 \times 10^4$ , and  $2.3 \times 10^3 \pm 1.1 \times 10^3$ , respectively. *C. perfringens*, *E. coli*, *Salmonella*, *Listeria monocytogenes*, and *Vibrio parahaemolyticus* could not be detected. The data also indicate that there were 16 % of samples rejected for higher total bacterial count; 44% were rejected for presence *S. aureus* count; 32% were rejected for presence of anaerobic count and 24% were rejected for presence of Coliforms count according to the Egyptian Standard, ES 288/2005 (EOS, 2005).

The presence of contaminated and pathogenic microorganism may be due to poor handling and /or improper storage methods and may be also due to poor personal hygiene and lack of sanitation during processing.

The data also indicate that one can depend on smoking to prevent growth of spoilage and/or pathogenic microorganisms. The data also indicate there are about 44% of samples were rejected microbiologically (*S. aureus*), while about 16% were rejected chemically (pH and TVN) and about 7% were rejected by sensory evaluation (Macerated and much macerated). So, depending upon sensory and chemical tests alone on determining hygienic quality of smoked fish is not always acceptable.

Nearly similar results were obtained by **Dodds et al. (1992)**, **El-Shater (1994)** and **El-Kewaley (2001)**. Higher results were obtained by **Daoud and Abd El-Azziz (1996)**, **Edris (1996)** and **Basawrows et al. (2000)**.

Strict hygienic measures should be taken during different stages of handling, transportation, storage, processing and marketing of smoked fish. The Egyptian fish industry needs, highly, to

follow the requirements of HACCP system or the more recent, Food Safety Management System, ISO 22000:2005.

Table (1): Statistical analytical results of sensory examination of Smoked Herring fish (n=25).

Skin condition			Skin colour				Consistency				Flesh odour		Flesh taste			
Intact	Macerated	much macerated	Golden brown	Golden yellow	Dark brown	Mouldy growth	Firm	Friable	Soft	Dry	Smoked fishy	Musty	Smokd fishy	Salty	Bitter	Musty
18	3	4	6	19	0	0	19	6	0	0	21	4	21	4	0	0
72%	12%	16%	24%	76%	0%	0%	76%	24%	0%	0%	84%	16%	84%	16%	0%	0%

Table (2): Statistical analytical results of chemical examination of Smoked Herring fish (n=25).

	Min.	Max.	Mean $\pm$ SE.	Accepted limit	Accepted	%	Rejected	%
pH	5.8	7.2	6.24 $\pm$ 0.08	LESS THAN 6.8	21	84	4	16
TVN	18	48	25.99 $\pm$ 1.68	LESS THAN 35	21	84	4	16

Table (3): Statistical analytical results of Microbiological Examination of Smoked Herring fish (n = 25).

	+ve	%	Mlo.	Max.	Mean $\pm$ SE.	Accepted limit	Accepted	%	Rejected	%
Total bacterial count	25	100	$2 \times 10^3$	$1.2 \times 10^6$	$7.4 \times 10^4 \pm 4.8 \times 10^1$	$1 \times 10^5$	21	84	4	16
<i>S. aureus</i> count	11	44	0	$6 \times 10^4$	$9.1 \times 10^3 \pm 3.9 \times 10^3$	Negative	14	56	11	44
Anaerobic count	20	80	0	$9 \times 10^3$	$7.1 \times 10^2 \pm 3.9 \times 10^2$	$1 \times 10^2$	17	68	8	32
Mold & yeast count	21	84	0	$5 \times 10^3$	$6.7 \times 10^2 \pm 2.3 \times 10^2$	No limit identified	25	100	0	0
Colliforms count	6	24	0	$3.5 \times 10^3$	$1.6 \times 10^2 \pm 1.4 \times 10^2$	Less than 10	19	76	6	24
Sporeforming count	25	100	X108	$2 \times 10^4$	$2.3 \times 10^3 \pm 1.1 \times 10^3$	No limit identified	25	100	0	0



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## الملخص العربى

## التقييم الحسى والكيميائى والميكروبيولوجى لأسماك الرنجة المدخنة

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تعد أسماك الرنجة المدخنة من أكثر منتجات الأسماك جذباً للمستهلك المصرى والتى تحتاج إلى كثير من العناية والاهتمام للرقابة عليها حتى لا تشكل خطراً على صحة المستهلكين لها.

وقد اهتمت هذه الدراسة بإجراء بعض التجارب العملية لاختبار الخواص الطبيعية والكيميائية والميكروبيولوجية لخمسة وعشرين عينة من أسماك الرنجة المدخنة والمصنعة محلياً والتي تم تجميعها عشوائياً من الأسواق المصرية وأظهرت النتائج أن ١٦٪، ٤٤٪، ٣٢٪ وأيضاً ٢٤٪ من العينات قد تم إستبعادها وعدم صلاحيتها للاستهلاك الأدمى وذلك لارتفاع مدى تلوثها الميكروبيولوجى من حيث العدد الكلى للميكروبات الهوائية، الكور العنقودى الذهبى، العدد الكلى للميكروبات اللاهوائية وميكروب القولون وتجاوزها الحدود المسموح بها طبقاً للمواصفة المصرية رقم ٢٨٨ لسنة ٢٠٠٥.

على الجانب الآخر أظهرت النتائج إستبعاد ٤٤٪ من العينات لعدم صلاحيتها ميكروبيولوجياً ١٦٪ لعدم صلاحيتها كيميائياً وكذلك ٧٪ من العينات لعدم صلاحيتها للاستهلاك حياً.

وقد تمت مناقشة النتائج وأهميتها الصحية وخلصت إلى التوصيات الراجب إتباعها والشروط الصحية وكذلك المواصفات القياسية لتحسين جودة هذا المنتج الذى هو فى غاية الأهمية والخطورة معاً.