

## Impact of chilling on the wholesomeness of different types of Sausages

Osama A. Attalla

Department of Food Hygiene and Control, faculty of Veterinary Medicine,  
Cairo University

### ABSTRACT

A total of 30 samples of sausages (10 of each of fresh oriental, semidry Alexandria and dry salami) were examined organoleptically and bacteriologically, beside measurement of pH. The collected samples were examined at the 1<sup>st</sup> day of arrival to the laboratory, then stored at 4°C and examined at 4<sup>th</sup> and 7<sup>th</sup> day of storage. The obtained results indicated that the organoleptical quality of the oriental and semidry Alexandria sausage samples subjected to deteriorative changes during chilling storage. Moreover, there was a positive correlation between the increase in the mean values of count of different bacterial group studied and the duration of chilling storage. On the other hand, the organoleptic quality of salami samples actually had been improved during chilling storage. At the same time, the mean values of *Staphylococci* and *Cl. perferinges* counts were higher than the permissible limit given in Egyptian standard specification (E.S.S.,4177/2003) (1). However, the results of the measurement of pH of different types of sausages indicated that the pH of fresh oriental sausage increased during storage, while that of semidry and dry salami sausages were decreased.

### INTRODUCTION

On a global basis, meat products have long been regarded as flavorful, nutritious and highly desirable food. They have been recognized also as an excellent source of high quality protein, fat, vitamins and minerals (2,3).

Sausages constitute a large sector of the Egyptian processed meat market, where fresh oriental and semidry Alexandria sausage are among the popular meat products in Egypt. The primary cuts used for manufacture of oriental and Alexandria sausages are those parts of the carcass of inferior quality which could not be utilized readily. On the other hand, salami production needs high quality fresh meat. In this respect, (4) sausages production in Egypt was widely varied in composition, nutritive value and their organoleptic properties. Moreover, samples of sausages are often contaminated with various kinds of microorganisms which could grow even at low temperature causing rapid deterioration and spoilage (5). Consequently fresh oriental sausages have very limited shelf life which not exceeding 4-7 days at refrigeration temperature.

The aim of the present work was to identify the effect of cold storage at 4°C on the organoleptical and bacteriological qualities of fresh oriental, semidry Alexandria, and dry salami sausages.

### MATERIALS AND METHODS

A total of 30 samples of Beef sausage (10 each of fresh oriental, semidry Alexandria sausage and dry salami) were collected from processing factories immediately after production. The samples were transferred directly to the laboratory in ice box and examined at the time of arrival and then at the 4<sup>th</sup> and the 7<sup>th</sup> days of chilling storage at 4°C to determine their quality attributes in terms of:

#### *Organoleptic quality*

Each type of sausage was evaluated organoleptically for odor, color and consistency (6) using 8-point rating scale. The scale has a varied range of score from 0 (bad) to 8 (very good).

#### *Bacteriological quality*

Ten grams of each sample were homogenized with 90 ml sterile Ringer's solution for 1 min. using stomacher (lab-

blender 400) to provide dilution of  $10^{-1}$ , then ten fold decimal serial dilution up to  $10^{-6}$  were prepared for determination of the counts of *Pseudomonas*, *Aeromonas*, *Enterobacteriaceae*, *Staphylococci*, *Cl. Perfringens*, Coliforms, and the aerobic plate count (7). In addition to isolation of *E-coli* (8), and the lactobacilli (9).

### Measurements of pH

The PH was calculated by the usual PH meter (10).

## DISCUSSION

The results of Table 1 revealed that the cross section of oriental and Alexandria sausage samples showed soft texture, normal spicy odor, presence of large fat particles, foreign tissues at the 1<sup>st</sup> day of examination. While, at the end of the 7<sup>th</sup> day of chilling storage, slime formation appeared and there was an increase in softness of texture and dark coloration especially in Alexandria sausage, which became organoleptically unaccepted. With regard to salami samples the organoleptic examination at the 1<sup>st</sup> day revealed acceptably brown color, firm texture and normal fermented odor. However, at the 7<sup>th</sup> day of chilling storage the samples showed dark brown color, hardness in texture, shrinkage of surface and increase in sourness but the product still organoleptically accepted.

Moreover, Table 2 indicated that the mean values of APC/g. of fresh oriental sausage at the 1<sup>st</sup> day of storage was  $6.45 \pm 0.85$  Log CFU/g. compared with  $7.75 \pm 1.07$  and  $8.55 \pm 1.20$  Log CFU/g at the 4<sup>th</sup> and 7<sup>th</sup> day of storage respectively. The higher count may be due to poor sanitary conditions of production, use of highly contaminated meat cuts as well as low quality spices and / or other food additives (11). Such results were nearly similar to those previously cited (12,13). On the other hand, lower values were recorded ( $1.6 \times 10^5$ /g.) (14).

The results given in Tables 2,3 and 4 pointed out that the mean values of *Pseudomonas* count of fresh oriental, Alexandria and salami samples ranged from  $5.3 \pm 0.70$  to  $6.2 \pm 0.702$ ,  $3.47 \pm 0.35$  to  $5.8 \pm$

$0.42$  and  $2.69 \pm 0.951$  to  $3.0 \pm 0.15$  Log CFU /g. at 1<sup>st</sup> to 7<sup>th</sup> day of storage. However, *Aeromonas* microorganisms failed to be isolated from any of the examined samples (Table 5).

The results of *Enterobacteriaceae* counts at the 7<sup>th</sup> day revealed higher counts in fresh sausage ( $6.2 \pm 0.77$  Log CFU/g.) in contrast to that of Alexandria sausage ( $4.2 \pm 0.77$  log cfu/g.) and salami samples ( $2.8 \pm 0.41$  log cfu / g. ). Moreover, the *Staphylococci* count in fresh oriental, Alexandria, and salami sausage increased from  $4.5 \pm 0.99$  to  $5.8 \pm 0.70$ ,  $5.0 \pm 0.31$  to  $6.0 \pm 0.52$  and  $3.2 \pm 1.305$  to  $3.0 \pm 0.20$  Log CFU/g. respectively at 1<sup>st</sup> to 7<sup>th</sup> day of storage. While Coliform count ranged from  $2.0 \pm 0.88$  to  $3.66 \pm 0.97$ ,  $3.2 \pm 1.02$  to  $3.63 \pm 0.72$  and  $0.48 \pm 0.007$  CFU/g. for the same product samples respectively. The obtained results are consistent with those recorded previously (15). In contrast Tolba (16) found that the mean values of *Staphylococci* and Coliforms counts/g. of fresh sausage were  $1.3 \times 10^5$  and  $2.5 \times 10^2$  respectively. Coliform and *Staphylococci* count in sausage bought from Egyptian markets were  $0.08 \times 10^3$  to  $16.0 \times 10^3$  cells / g. (17). It is of importance to recognize that *E-coli* could be isolated from 30% of fresh and 20% of Alexandria sausage using API 20 technique (Table 5), whereas failed to be isolated from any of the examined salami samples. Such results were in harmony with those recorded by several investigators (18,19).

It is worth to mention that presence of *E-coli* with high percentage in raw meat products provide evidence of direct or indirect faecal contamination and unsatisfactory hygienic condition during different production steps (20). Moreover spices and other food additives may constitute another source of contamination.

Concerning *Cl. perfringens* it was clear that the mean count/g. at the 1<sup>st</sup> day of storage of the examined sausage samples was  $4.0 \pm 0.653$ ,  $4.5 \pm 0.75$  and  $2.2 \pm 0.801$  log CFU/g. for oriental, Alexandria and salami sample respectively. Although the incidence of *Cl. perfringens* in sausage samples was lower

than previously reported (21). *Cl. perfringens* may find their way in sausage either from direct contamination of the meat or by subsequent contamination from the hands or cookers, butchers, meat handlers, and retail shops (22). The author added that samples contaminated with more than  $10^5$  *Cl. perfringens*/g is considered to be unfit for human consumption due to the presence of microbial toxins.

Lactobacilli bacterial count in Alexandria and salami sausage was higher than that in oriental sausage which may be attributed to using of a starter culture in process of production of such products. The most common species of lactobacilli used in fermentation process are *L-plantarm* and *kasei* (23). Traditional fermentation process of salami relied on chance and random inoculation of wild microorganism from the environment; these microorganisms were predominately Micrococci, Staphylococci, which are necessary for the reduction of nitrate to nitrite for formation of the cured meat color and flavor. Streptococci and lactobacilli effected the fermentation process by conversion of added sugar primary to lactic acid, reducing pH and the production of tangy flavor and product stability.

The reduction of pH in samples of semidry Alexandria sausage and dry salami sausage could be attributed to the proteolytic

activity of starter culture towards meat proteins during fermentation process of sausage causing dropping of pH at the end of incubation process. It is of interest to emphasize the significance of psychrophilic *Pseudomonas* bacteria which are considered as responsible caustive organisms for spoilage of refrigerated food (24).

Table 6 illustrated the pH values of different types of sausages, where the mean pH value of oriental sausage reach (7.2) at 7<sup>th</sup> of cold storage. On the other hand, the mean pH values of Alexandria and salami sausage samples were 5.7 and 4.7 respectively. In this regard, the pH of sausage increased with the extension of cold storage (25). Meanwhile, similar results concerning the pH of salami samples was recorded which indicated decreased the pH value during rippening time. Moreover, the results obtained during the present study indicated that there was a close relationship between the bacterial load of the different groups of bacteria and the pH.

From the previous data and discussion, it is concluded that the main causes for bacterial contamination of sausages are mishandling, improper hygienic measures during manufacturing and transportation, storage conditions, retail distribution, as well as the quality of the meat cuts incorporated during the processing and production of the different types of sausages.

## RESULTS

**Table 1. Organoleptic Evaluation of different types of sausages sample stored at 4°C. (n=10)**

Storage/day Criteria	Type of Sausage								
	Oriental			Alexandria			Salami		
	1 <sup>st</sup>	4 <sup>th</sup>	7 <sup>th</sup>	1 <sup>st</sup>	4 <sup>th</sup>	7 <sup>th</sup>	1 <sup>st</sup>	4 <sup>th</sup>	7 <sup>th</sup>
Color	6	4	2	5	3	2	6	7	7
Odor	7	5	4	6	5	5	5	6	7
Consistency	4	2	1	5	4	3	5	6	7

Table 2. Bacterial Counts Log CFU/g of the examined fresh Oriental sausage samples

Storage day		APC	Pseudomonas	Enterobact.	Staphylococci	Coliforms	CL. perfringens	Lactobacilli
1 <sup>st</sup>	Max.	6.8	5.4	4.2	5.0	2.2	4.6	2.2
	Min.	5.1	4.1	3.9	2.2	0.48	3.2	<1.0
	Mean.	6.45	5.3	4.0	4.5	2.0	4.0	2.0
	SD ±	0.85	0.70	0.11	0.99	0.88	0.65	0.60
4 <sup>th</sup>	Max.	7.9	6.1	5.3	5.1	3.9	4.8	4.0
	Min.	5.8	5.0	4.2	3.9	0.48	3.8	1 <
	Mean.	7.75	5.8	4.95	5.0	3.6	4.3	3.78
	SD ±	1.07	0.51	0.51	0.59	1.01	0.45	1.20
7 <sup>th</sup>	Max.	8.9	7.0	6.6	6.0	4.2	5.8	4.9
	Min.	6.1	5.5	5.0	4.5	2.2	4.6	3.2
	Mean.	8.55	6.2	6.2	5.8	3.66	5.2	4.0
	SD ±	1.20	0.70	0.77	0.70	0.97	0.55	0.80

Table 3. Bacterial Counts log cfu / g of The examined Alexandria sausage samples (n=10).

Storage day		APC	Pseudomonas	Enterobact.	Staphylococci	Coliforms	CL. perfringens	Lactobacilli
1 <sup>st</sup>	Max.	6.0	4.0	4.0	5.2	3.4	5.1	6.0
	Min.	3.4	3.2	<1	4.5	0.48	3.5	3.4
	Mean.	6.0	3.47	3.0	5.0	3.2	4.5	6.0
	SD ±	1.32	0.35	1.40	0.31	1.02	0.75	1.32
4 <sup>th</sup>	Max.	6.1	5.0	4.2	5.8	3.5	5.8	6.1
	Min.	3.5	4.5	<1	4.8	0.48	4.2	3.5
	Mean.	6.0	5.3	3.6	5.2	3.38	5.0	6.0
	SD ±	1.30	0.32	0.55	0.45	1.61	0.75	1.30
7 <sup>th</sup>	Max.	6.8	5.9	4.5	6.2	4.0	6.0	6.8
	Min.	4.2	5.0	3.0	5.1	2.5	4.2	4.2
	Mean.	6.69	5.8	4.2	6.0	3.63	5.5	6.69
	SD ±	1.30	0.42	0.77	0.52	0.72	0.87	1.30

Table 4. Bacterial Counts Log CFU / g of the examined Salami sausage samples

Storage day		<i>Pseudomonas</i>	Enterobact.	<i>Staphylococci</i>	Coliforms	<i>CL. perfringens</i>	Lactobacilli
1 <sup>st</sup>	Max.	2.7	2.2	3.5	0.48	2.6	4.1
	Min.	<1	<1	<1	0.48	<1	3.0
	Mean.	2.69	2.0	3.2	0.48	2.2	4.0
	SD ±	0.95	0.60	1.30	0.007	0.80	0.54
4 <sup>th</sup>	Max.	2.8	3.0	3.5	0.48	2.1	5.0
	Min.	2.1	<1	2.8	0.48	<1	3.4
	Mean.	2.72	2.8	3.0	0.48	2.0	5.6
	SD ±	0.32	0.04	0.31	0.007	0.57	0.97
7 <sup>th</sup>	Max.	3.2	3.0	3.3	0.48	2.5	5.8
	Min.	2.8	2.1	2.8	0.48	<1	3.5
	Mean.	3.0	2.8	3.0	0.48	2.1	5.6
	SD ±	0.15	0.41	0.20	0.007	0.79	1.23

Table 5. Incidence of different Bacteria in examined sausage samples (n=10)

	APC		<i>Pseudomonas</i>		<i>Aeromonas</i>		Enterob.		<i>Staphylococci</i>		Colifoems		<i>E. Coli</i>		Cl. perf.		Lactobacilli	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Oriental	7	70.0	10	100.0	-	-	9	90.0	10	100.0	10	100.0	3	30	10	100.0	10	100.0
Alexandria	10	100.0	10	100.0	-	-	8	80.0	10	100.0	10	100.0	2	20	10	100.0	10	100.0
Salami	10	100.0	5	50.0	-	-	-	-	10	100.0	8	80.0	-	-	10	100.0	10	100.0

Table 6. Mean pH values of examined sausage samples.

Storage / Day	Sausage		
	Oriental	Alexandria	Salami
1 <sup>st</sup> day	6.5	6.2	6.0
4 <sup>th</sup> day	6.8	6.0	5.5
7 <sup>th</sup> day	7.2	5.7	4.7

n=10

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### الملخص العربي

## دراسة مدي تأثير عملية الحفظ بالتبريد علي جودة الأنواع المختلفة من السجق

أسامة علي عطالله حسن

مدرس الرقابة الصحية علي اللحوم ومنتجاتها

قسم الرقابة الصحية علي الأغذية-كلية الطب البيطري - جامعة القاهرة

اجريت هذه الدراسة علي عدد ثلاثين عينة (عشر عينات) من كل من السجق البلدي (الطازج) والسجق النصف الجاف (الإسكندراني) والسجق الجاف (السلامي) تم الحصول عليها من مصانع الإنتاج الخاصة بكل نوع بعد إنتاجها مباشرة ، حيث تم نقلها في ثلاجة حفظ إلي المعمل لفحصها ظاهرياً وبكتريولوجياً، وكذلك قياس تركيز الأيون الهيدروجيني. وتمت عملية الفحص مباشرة بعد نقل العينات إلي المعمل وأيضاً بعد أربعة وسبعة أيام من الحفظ عند درجة 4م°.

وقد أظهرت نتائج الفحص الظاهري لكلاً من عينات السجق البلدي والإسكندراني حدوث إنخفاض في الجودة الحسية وأن العينات غير مقبولة حيث أصبح القوام أقل تماسكاً كما تأثر كلا من اللون والرائحة سلباً، وقد إزداد التدهور في تلك الخواص مع زيادة فترة الحفظ. وقد لوحظ أيضاً زيادة مطردة في أعداد البكتريا المعزولة وأيضاً إرتفاع في تركيز الأيون الهيدروجيني فوصلت إلي ٧ و ٥ و ٧ في السجق البلدي والإسكندراني علي التوالي في اليوم السابع من عملية الحفظ .

أما بالنسبة لعينات السلامي فقد لوحظ أنها أصبحت أكثر جفافاً والرائحة أكثر تخمراً مع ملاحظة إنخفاض في معظم أعداد البكتريا المعزولة وإنخفاض تركيز الأيون الهيدروجيني فوصلت إلي ٧ و ٤ مع اليوم السابع من عملية الحفظ.

كما تمت مناقشة الأهمية الصحية للنتائج وكذلك تأثير مدي تواجد الميكروبات المعزولة علي جودة المنتج والصحة العامة. وخلصت النتائج إلي أن الحفظ بالتبريد عند 4م° غير كاف لحفظ تلك المنتجات.