

Microbiological Quality of Cured Meat in Jeddah Markets

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ABSTRACT. In this investigation samples of preserved cured meat products were collected from different Jeddah markets in five replicates. These include: basterma, beef mortadella with different kinds of spices, smoked beef loaf, smoked turkey roast and sausage. These products were analyzed for different parameters of microbiological quality. These determinations include: total microbial flora, thermoduric mesophiles, thermophilic anaerobes, acid producing bacteria, coliform bacteria, *Salmonella* and *Shigella*.

Considerable differences in the total microbial density were observed in different cured meat products. Beef mortadella with pistachio showed outstanding higher microbial load compared to other products, followed by beef mortadella with pepper and sausage. The lowest microbial count was observed in basterma. Most of the microbial flora of preserved cured meat products were thermolabile organisms while thermophiles were of minor importance. Acid producing microorganisms were detected in varying densities. These preserved meat products were found to harbour considerable densities of microorganisms able to grow on MacConkey medium, among them lactose fermentors were predominant. However, non-lactose fermentors appeared in comparatively high density. The presence of enteric pathogens was again observed by plating on S-S agar. This study indicates that all examined cured meat, except smoked turkey roast, contained high density of *Salmonella-Shigella* group. Thus, careful inspection of these products should be intensified.

Introduction

The study of the microbial quality of preserved cured meat products is important from the public health point of view. Most of these food products are ready-to-eat without any need for further cooking. Thus contamination of these products with intestinal pathogens is considered a serious problem. Contamination of these products with pathogens may occur through improper handling, processing and storage. The

factory utensils, workers and the surrounding atmosphere are considered the most important sources of contamination with pathogens^[1].

The presence of coliform bacteria in these foods may be taken as one of the most important parameters of contamination with pathogens. Coliforms are always present in meat products condemned for foodborne outbreaks^[2]. Moreover, because of the continuing occurrence of *Salmonella* in foods, their study received great attention^[3].

In this investigation the microbial quality of preserved cured meat products present in Jeddah markets was evaluated. These products include basterma, sausage, different kinds of beef mortadella, smoked turkey roast and smoked beef roast.

Material and Methods

Samples of preserved cured meat products available in Jeddah district were collected from different markets. These products include: basterma, sausage, beef mortadella with pepper, beef mortadella with pickled green olives, beef mortadella with pistachio, smoked turkey roast and smoked beef roast. Each product was collected from five different distributors. All these products were subjected to microbiological analysis soon after collection. For microbiological analysis 50g representative sample from each replicate was put into sterile blender jar with 450 ml sterile water and mixed at 10 speed for few seconds followed by high speed for 2 minutes^[4]. Serial dilution were then made as usual.

Microbiological analyses were carried out to determine: total microbial flora and thermophilic mesophiles on plate count agar, thermophilic anaerobes on thioglycolate agar, acid producing bacteria on dextrose tryptone agar with indicator, coliform group on MacConkey agar and *Salmonella-Shigella* group on S-S agar. All these determinations were carried out according to Leininger^[5].

Results

Figure 1 shows the average total microbial densities in different preserved cured meat products collected from Jeddah markets. The data indicate wide variation in their microbial load. The lowest density was recorded in Basterma followed by beef mortadella with pickled green olives (9.2×10^3 and $91 \times 10^3/g$ respectively). The highest microbial density, on the other hand, was observed in beef mortadella with pistachio where the average count reached $1.08 \times 10^7/g$.

Data illustrated in Fig. 2 show that the counts of thermophilic mesophiles showed their highest value also in beef mortadella with pistachio where the average count reached $55 \times 10^3/g$. Comparatively higher density of this group was also observed in sausage ($25.8 \times 10^3/g$) and smoked beef roast ($22.5 \times 10^3/g$). Smoked turkey roast, on the other hand, showed the lowest density of thermophilic mesophiles.

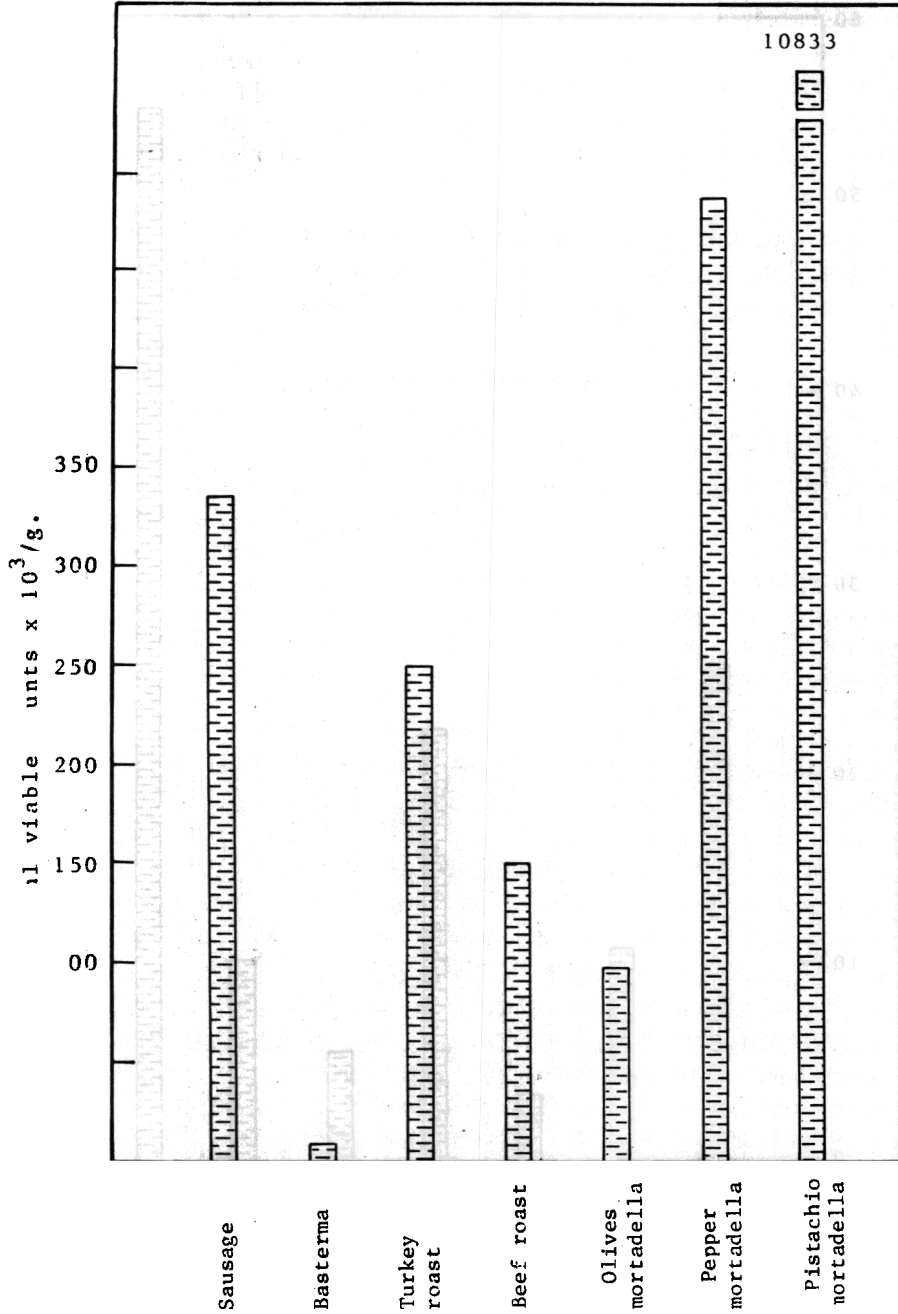


FIG. 1. Total microbial densities in different cured meats.

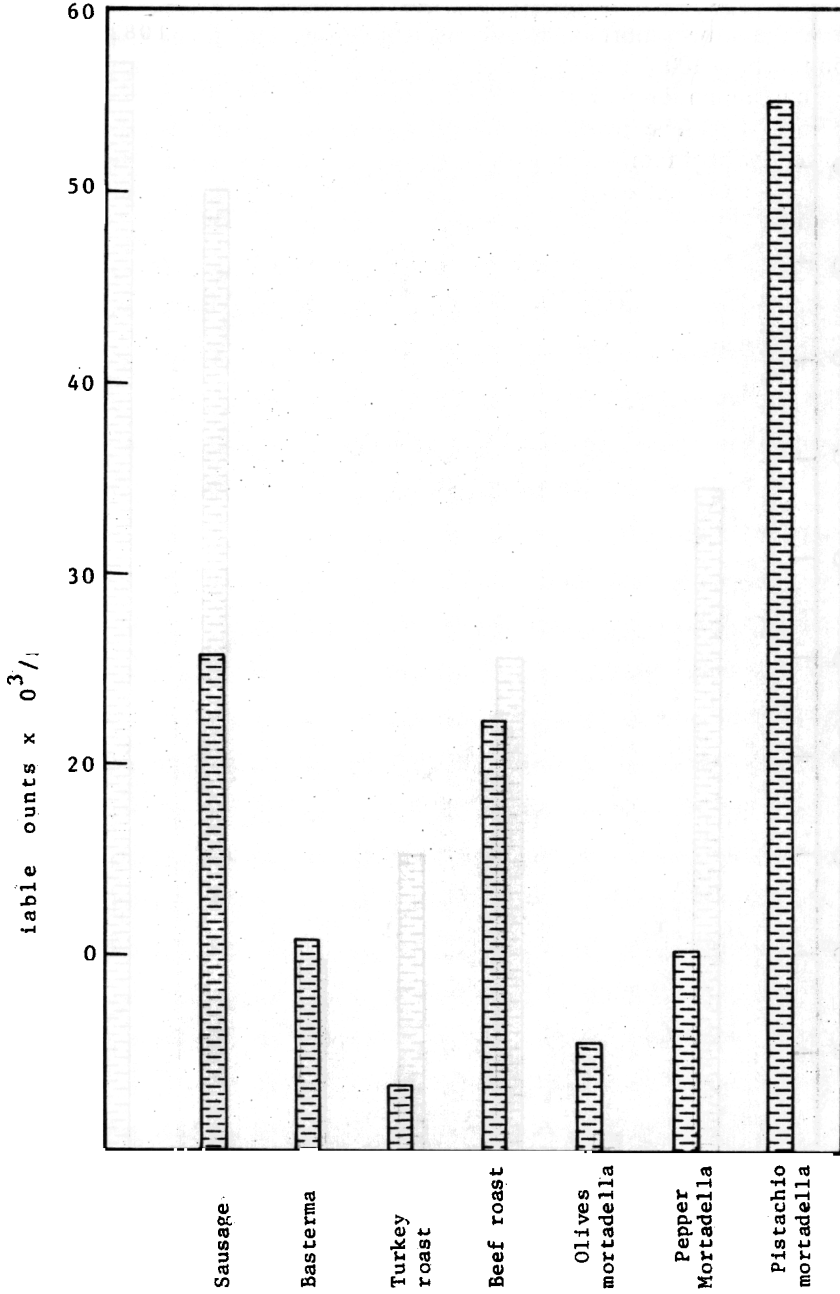


FIG. 2. Densities of thermophilic mesophiles in different cured meats.

With respect to the densities of thermophilic anaerobes in different preserved cured meat products, the data in Fig. 3 showed considerably wide variation in their abundance. Again, beef mortadella with pistachio showed the highest level of contamination reaching $100.0 \times 10^3/g$. Smoked turkey roast came next with respect to the rate of contamination with thermophilic anaerobes, since the average density reached $37.5 \times 10^3/g$. The lowest count for this group was recorded in smoked beef roast followed by beef mortadella with black pepper being $5 \times 10^3/g$ respectively. *Basterma*, beef mortadella with pickled green olives and sausage showed intermediate results.

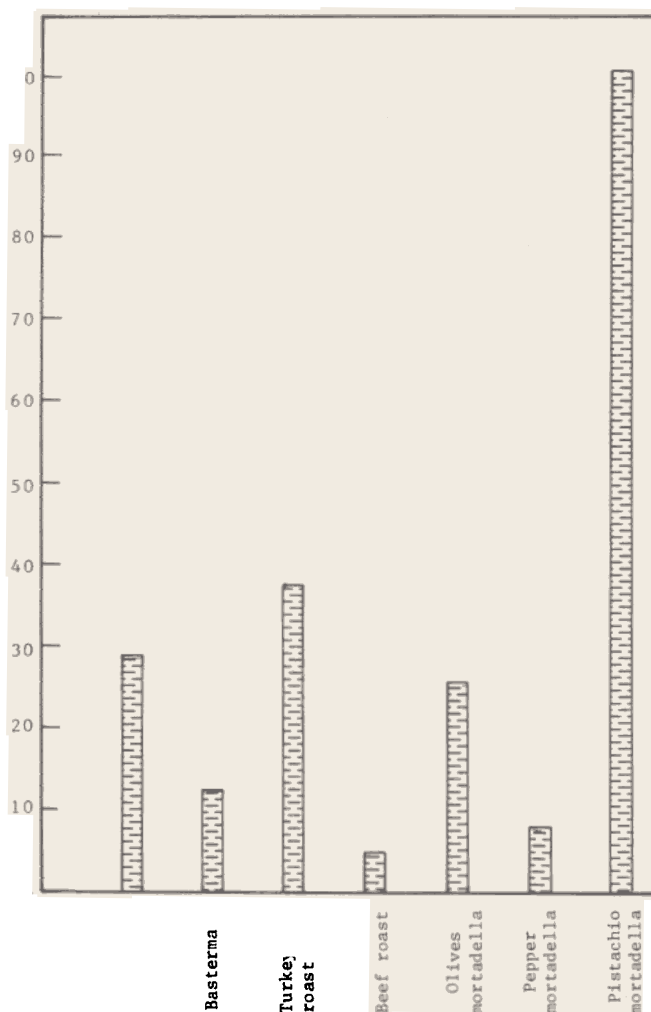


FIG. 3. Densities of thermophilic anaerobes in different cured meat:

From all the aforementioned results it is clear that although thermophilic mesophiles and thermophilic anaerobes showed considerable variations in different preserved cured meat products, yet they always represent only a small fraction of the total microbial flora in these products. Thus, most of the microbial flora of these foodstuffs are thermo-labile organisms.

The highest density of acid producing bacteria (Fig. 4) which may cause souring of these popular foods was observed in sausage ($90 \times 10^3/g$). Beef mortadella with pistachio showed also comparatively higher density of this group reaching an average of $36.7 \times 10^3/g$. However, beef mortadella with pickled green olives showed the lowest contamination with acid producing bacteria ($1.3 \times 10^3/g$) followed by basterma ($6.9 \times 10^3/g$). Smoked turkey roast, smoked beef roast and beef mortadella with black pepper showed moderate contamination levels.

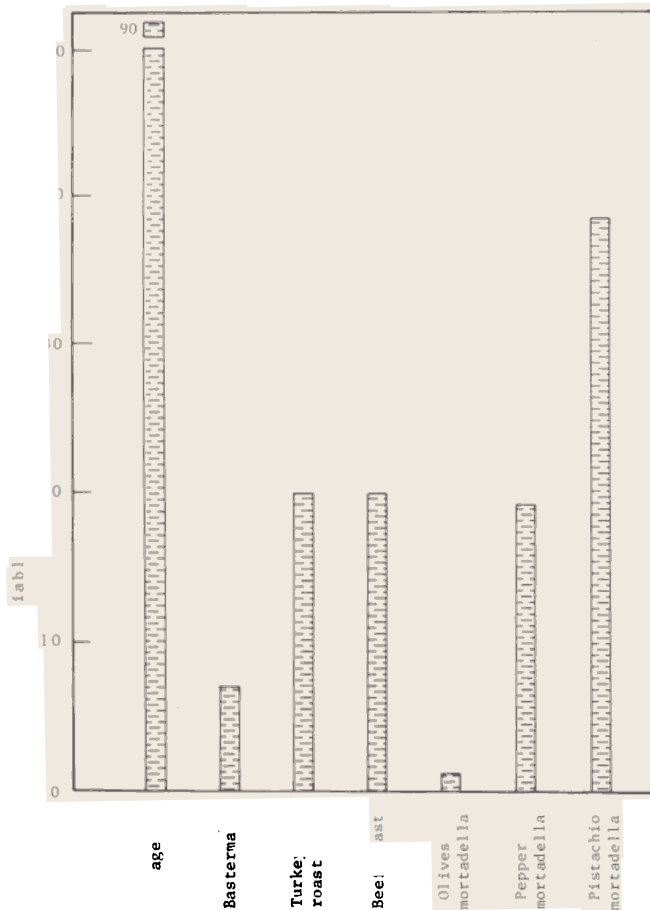


FIG. 4. Densities of acid producing bacteria in different cured meats.

It was found of great importance to determine the possibility of fecal contamination of preserved cured meat products. Such study is highly important since most of these products are eaten without any further thermal treatment. Thus the presence of enteric pathogens in these foodstuffs will be a serious problem. Results of this study are illustrated in Fig. 5. It is clear from the data obtained that all the investigated cured meats contain microorganisms able to grow on MacConkey selective medium. Colony counts on MacConkey agar reached their highest level, in sausage (6250/g). Comparatively high colony count appeared on MacConkey agar in the case of beef mortadella with black pepper, beef mortadella with pickled green olives, beef mortadella with pistachio and basterma in decreasing order. Both beef and turkey smoked roast, however, showed low count for this group. Lactose fermentors, mostly coliforms, showed the same general trend as total colony counts on MacConkey plates. Moreover, all the investigated preserved cured meats showed considerable counts of non-lactose fermentors except basterma, smoked turkey roast and beef mortadella with pistachio.

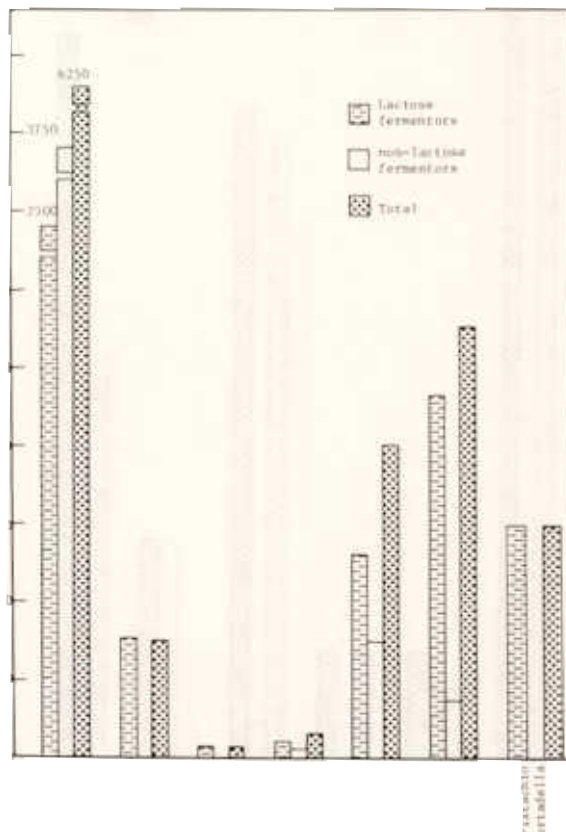


FIG. 5. Microbial counts on MacConkey agar in different cured meats.

Results obtained from the study on MacConkey agar was considered serious from the hygienic point of view. It condemned these products as a possible source of enteric diseases. Thus to be sure of these results counts of microorganisms appearing on S-S agar were carried out. Total colony count together with enumeration of non-lactose fermenting, typical colonies of *Salmonella* and *Shigella*, were recorded on S-S plates. Figure 6 shows that the total colony counts on S-S agar showed nearly similar trend as those obtained on MacConkey plates. However, only smoked turkey roast was found to be free from non-lactose fermenting colonies. The presence of high densities of organisms showing typical characteristics of *Salmonella* and/or *Shigella* especially in sausage, beef mortadella with black pepper and smoked beef roast indicated non-hygienic production control.

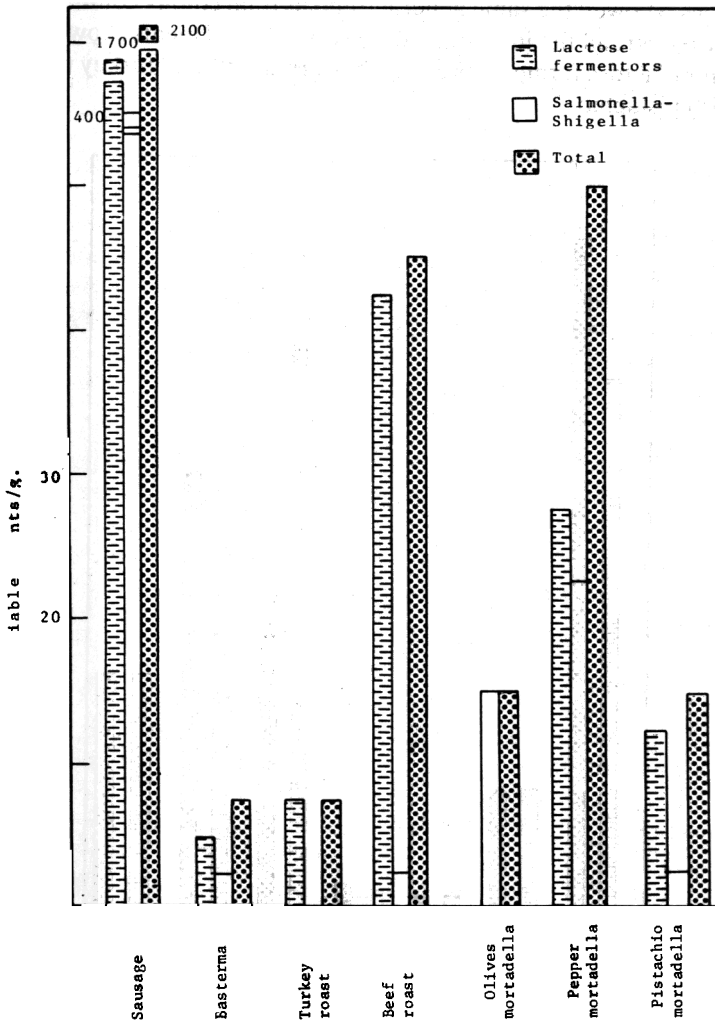


FIG. 6. Microbial counts on S-S agar in different cured meats.

Discussion

It is well known that the microflora of any foodstuff are qualitatively and quantitatively affected by so many factors. Important among them are the physical and chemical properties of food, its ingredients, presence of inhibitors or stimulators, the microbial load of raw materials, sanitary conditions of production, the extent of the thermal treatment, ... etc. Since wide differences exist in these factors in the examined cured meat products, wide differences in the microbial load are expected.

The total microbial flora showed clear variation in density in different preserved cured meat products collected from Jeddah markets. The lowest count was in basterma. This finding may be a reflection of its high nitrite treatment. Such treatment is known to chick meat spoilage organisms^[6, 7]. Moreover, the thick casing of basterma with spices, natural stains and garlic may play an important role in inhibiting microbial growth. In the same time basterma is prepared from one thick piece of muscle, and it is known that internal tissues of such thick pieces are sterile if obtained from healthy animal^[8].

The highest total microbial load, observed in beef mortadella with pistachio could be partially due to the physical conditions of this product. The presence of pistachio inside the minced meat makes the product less compact, enabling aerobic microbial growth. Moreover, pistachio itself may be a source of a part of the microbial load, since it is known to be liable to rapid spoilage. Chipley and Heaton^[9] stated that nuts contain many kinds of microorganisms reflecting the conditions of harvesting and storage. As an example of nuts King *et al.*^[10] made microbiological analysis of almond and found the log total count on it to reach 3.85 while log fungi and yeasts reached 4.67.

Considerable part of the microflora present on different kinds of beef mortadella and sausage comes from minced beef. Minced meat is known to be prepared from low quality small meat pieces which may contain high microbial load. Moreover, the mincing process mixes the contaminating bacteria with the whole meat body and make the physical conditions of meat more suitable for microbial growth^[11].

Results of this study indicate that most of the microflora of cured meat products are thermo-labile. The densities of thermophilic and thermoduric organisms represented only a small fraction of the total microflora. This denotes that most of the microflora in cured meat are active non-sporulating organisms. This finding is in accordance with many investigators. Jensen^[12] and Handford and Gibbs^[13] found that smoking has little effect on *Streptococcus*, *Pediococcus* and *Leuconostoc* spp. Faparusi^[14] found that Khandi (a kind of smoked dried meat) contains 12 species of bacteria, 10 species of yeasts and 16 species of fungi. On the other hand, Ayres *et al.*^[15] and Loiter *et al.*^[16] found that *Pseudomonas*, *Achromobacter*, *Lactobacillus* and *Micrococcus* increased in sausage during storage. Drake *et al.*^[17] found salami and bologna (cured meat products) to contain *Micrococci bacilli*, *Sarcina lactobacilli*, *Streptococci* and *Micrococci*.

The presence of acid producing microorganisms in the investigated cured meats especially in sausage is in accordance with Dowdell and Board^[18], Loiter *et al.*^[16] and Tyoberg *et al.*^[19].

Determination of fecal contamination of cured meat products is highly important from hygienic point of view. Standard methods for examination of dairy product^[2] recommended the use of MacConkey agar for direct examination of coliform group. The presence of coliforms in cured meat may indicate the possibility of presence of enteric pathogens. Their presence indicates non-sanitary conditions of production. Gangarosa and Hughes^[2] standed from their study of 2.211 foodborne outbreaks in United States, that most of them could be due to improper handling and unsanitary conditions of production and storage. The presence of high density of coliform bacteria in sausage is in accordance with Dowdell and Board^[18] who found the log number of coliforms in British sausage lies between 0-4.71. The presence of coliforms in sausage was also recorded by El-Nemr^[20] and Shehata *et al.*^[21]. Dalinger and Kenneby^[22] studied the microflora of frankfurters, turkey roast, beef roast, basterma and meat loaves in Florida. Their study indicated that 73.8% of the samples were coliform positive and 11.3% contain *E. coli*.

The presence of microorganisms showing typical resemblance to *Salmonella* and/ or *Shigella* in cured meat products is a serious problem since most of these products are utilized without further thermal treatment. Careful inspection of raw materials, production lines and storing conditions should be intensified to eliminate serious contamination of these products with human pathogens. The results are in accordance with Gangarosa and Hughes^[2] who found that 78% of foodborne outbreaks in United States during 1967-1975 came from minced meat, 22% from frankfurters and 11% luncheon meat. Moreover, Bryan *et al.*^[1] were able to isolate pathogenic bacteria from 22.3% turkey meat before processing. *Salmonella* was present in 26.8% uncooked turkey rolls and on 24% factory utensils. It was also detected on hands and gloves of workers in these factories.

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التقويم الميكروبيولوجي للحموم المعالجة المحفوظة في منطقة جدة

كمال بن عباس توفيق ، عبد الوهاب محمد عبد الحافظ و عادل عبد الكريم فدا
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أجريت هذه الدراسة على مجموعة من منتجات اللحم المعالجة المتوافرة بمنطقة جدة ، وتتضمن البسطرمة ومختلف أنواع المورتديلاً البقري والروستو الرومي المدخن والروستو البقري المدخن والسجق . ولقد جمعت هذه العينات من مختلف الموزعين في خمسة مكررات حيث حللت ميكروبيولوجياً لتقدير الأعداد الكلية للميكروبات والبكتيريا المقاومة للحرارة والبكتيريا المحبة للحرارة اللاهوائية والبكتيريا المنتجة للأحماض ومجموعة القولون ومجموعة السلمونيلاً والشيجيلاً .

ولقد تبين من هذه الدراسة ما يلي :

أ - ظهرت اختلافات كبيرة في الأعداد الكلية للميكروبات بين مختلف منتجات اللحم المعالجة ، ولقد أظهرت المورتديلاً المشوية بالفسق أعداداً كلية ضخمة مقارنة مع مختلف أنواع اللحم المحفوظة المدروسة ، يليها المورتديلاً بالفلفل الأسود والسجق ، في حين كانت أقل الأعداد في حالة البسطرمة .

ب - لقد كانت أغلب الميكروبات الموجودة في اللحم المعالجة من الأنواع غير المقاومة للحرارة في حين كان للبكتيريا المقاومة والمحبة للحرارة دور محدود في هذه المنتجات . كما اختلفت كثافة البكتيريا المنتجة للأحماض في العينات موضع الدراسة .

ج - احتوت هذه اللحم المعالجة على أعداد كبيرة من الميكروبات التي تستطيع أن تنمو على بيئة ماكونكي الانتخابية ، وكانت الأنواع المخمرة للأكتوز التابعة لمجموعة القولون تمثل النسبة الغالبة من هذه الميكروبات الأمر الذي يوضح أن الشروط الصحية غير متوافرة في إنتاج هذه الأغذية . كما لوحظ وجود أعداد لا بأس بها من البكتيريا غير المخمرة للأكتوز التي تنمو على بيئة ماكونكي الأمر الذي يُحتمل معه وجود بكتيريا مرضية معوية في هذه الأغذية .

د - للتأكد من النتيجة السابقة ، قدرت أعداد الميكروبات التي تستطيع أن تنمو على بيئة S-S agar الانتخابية . ولقد أظهرت الدراسة أن مختلف اللحم المعالجة أعطت أعداداً كبيرة من المستعمرات التي تنطبق عليها مواصفات السلمونيلاً والشيجيلاً الأمر الذي يؤكد احتمال وجود ميكروبات مرضية معوية في هذه الأغذية ، ومن ثم يؤكد أن الشروط الصحية للإنتاج غير متبعة في إنتاج هذه الأغذية .