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**BEHAVIOR OF SALMONELLA TYPHIMURIUM IN MINCED MEAT
AT DIFFERENT HOLDING TEMPERATURES
AND DURING ITS THERMAL PROCESSING**
(With One Table)

By

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نمو ميكروب السالمونيلا ومدى حيويته أثناء حفظ اللحم المفري
في درجات الحرارة المختلفة وكذلك أثناء شية

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أختير عترة من ميكروب السالمونيلا وحفظها في اللحم المفري . ثم تقسيم اللحم المفري بعد ذلك إلى مجموعتين متساويتين : المجموعة الأولى تم تقسيمها إلى ثلاثة أقسام متساوية وحفظت عند درجات ٢٠ - ٢٥ - ٢٠ ، وبالكشف الدوري على اللحم المفري عند درجة ٢٠ - ٢٥ بعد صفر ١٢ ، ٢٤ ، ٢٦ ، ٤٨ ساعة وكذلك المحفوظة عند درجة ٤م بعد الصفر ، ٢٠ ، ٢٥ ، ٢٠ ، ١٤ ، ٧ ، ٦ ، ٥ ، ٤ ، ٣ يوم والمحفوظة عند درجة ٢م بعد الصفر ، ٢٠ ، ٢٠ ، ٢٠ ، ٤ ، ٤ ، ٣ لمعرفة عدد ميكروب السالمونيلا تبين أن هذه الميكروب ينمو بزيادة كبيرة في اللحم المفري المحفوظ عند درجة ٢٠ - ٢٥ م بينما ينقص العدد في اللحم المفري المحفوظ عند درجة ٢٠ م . والمجموعة الثانية من اللحم المفري الذي تم حفظه تم إختبارها بتأثير حرارة الشوي على ميكروب السالمونيلا . وجد أن أقصى درجة حرارة التجارب أثناء عملية الشوي تتراوح بين ٧٠ إلى ٨٠ م . ووجد أن ميكروب السالمونيلا لا يستطيع مقاومة حرارة الشوي ويختفي نهائياً بعد الشوي . وقد تم مناقشة الأهمية الصحية لوجود هذا الميكروب وسومه على الصحة العامة .

SUMMARY

Minced meat was experimentally inoculated by Salmonella typhimurium strain and then divided into two parts: The first of which was subdivided into three equal parts and kept at different holding temperatures: 20-25°C for 48 hours; 4°C for 14 days and -20°C for 5 weeks respectively. An obvious increase in Salmonella typhimurium count kept at 20-25°C had occurred, while a noticeable reduction in counts had occurred in samples kept at (-20°C). The second part was performed to find out the effect of thermal processing of minced meat on Salmonella typhimurium, the maximum internal temperatures of the sample during grilling on coke fire ranged from 70°C-80°C. The strain of Salmonella typhimurium could not resist the heating process of minced meat and was completely destroyed. Public health importance of the obtained results were discussed.

INTRODUCTION

Salmonellosis is one of the most prevalent and more serious forms of food borne diseases and is frequently associated with consumption of insufficiently cooked meat and meat products (GOEPFERT and CHUNG, 1970; SMITH *et al.*, 1975; GOOD-FELLOW and BROWN, 1978 and MORRISON and FLEET, 1985).

Growth rate of *Salmonella* organisms begins to increase at a temperatures more than 5°C (RIVITUSO and SNYDER, 1981). (GOEPFERT and CHUNG, 1970) reported that the *Salmonellae* decreased in number in the intact sausages held under refrigeration.

Salmonella survival was greatly affected by the processing temperature (MASTERS *et al.*, 1981). RICHARD (1985) recorded that no viable food poisoning organisms were found in sausages that had been heated at an internal temperature of 57.8-58.9°C.

The aim of this study was to :

- 1- Evaluate the role of storage temperatures in controlling the growth of *Salmonella typhimurium* in minced meat.
- 2- The effect of thermal processing of minced meat on *Salmonella typhimurium* organisms.

MATERIAL and METHODS

Salmonella culture :

Salmonella typhimurium strain used in this study was obtained from the Animal Health Research Institute. Stock culture was maintained on nutrient agar slant and grown for 18-24 hours in nutrient broth (Difco).

Preparation of samples :

Minced beef meat samples were prepared under sterile conditions in the laboratory. The minced meat was examined for the presence *Salmonellae* as follows: 10 gm portion from the sample was added 200 ml selenite F broth (Difco) for enrichment incubated at 37°C for 18-24 hours then streaked on to SS agar (Difco). suspected *Salmonella* colonies were identified biochemically and serologically according to CRUICKSHANK (1980).

Inoculation and Enumeration :

The tested strain was counted after inoculation into nutrient broth and incubation for 18-24 hours by diluting 10 folds on nutrient agar plates.

The prepared *Salmonella* strain culture was (the approximate count was 10^7 cells/ml) well mixed with minced meat under sterile conditions (SMITH *et al.*, 1975) and then divided into two parts: The first part was subdivided into three equal parts and kept at different holding temperatures (20-25°C for 48 hrs.; 4°C for 14 days and -20°C for 5 weeks) representing the normal keeping and refrigeration conditions.

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10 gm from each inoculated minced meat at different holding temperatures were weighed and mixed with 90 ml sterile 0.1% peptone water in a blender jar and was mixed for 2.5 minutes (2000 r.p.m) to provide a dilution 10^{-1} , serial dilutions were prepared from the original dilution then streaked on SS agar plates and incubated at 37°C for 18-24 hours. The second part was grilled on coke fire for 15-20 minutes, the maximum internal temperature of inoculated minced meat was recorded. The grilled minced meat samples were then inoculated into selenite broth (Difco) for 18-24 hours and streaked on SS agar plates to examine its viability.

Bacterial counts were determined at time of inoculation, 12, 24, 36 and 48 hours for minced meat held at 20-25°C; at time of inoculation, 1,2,3,4,5,6,7 and 14 days for those held at 4°C and at time of inoculation, 1,2,3,4, and 5 weeks for minced meat held at -20°C.

RESULTS

The obtained results are recorded in table (1).

DISCUSSION

The growth of the *Salmonella typhimurium* strain in minced meat during storage as calculated from confirmed colonies on SS agar are presented in table (1).

The counts of *Salmonella typhimurium* after inoculation held at 20-25°C were 12×10^5 , 16×10^5 , 1×10^7 , 11×10^8 and 2×10^8 /gm in time of inoculation, 12,24,36 and 48 hours respectively. The results indicated that large increase had occurred in counts which agreed with the findings recorded by (GOEPFERT and CHUNG, 1970 and DOYLE *et al.*, 1982). RIVITUSO and SNYDER (1981) reported that the growth of total aerobes initiates most rapid increase at 20°C.

The counts of *Salmonella typhimurium* organisms in minced meat held at 4°C were 12×10^5 , 10×10^5 , 9×10^5 , 9×10^5 , 11×10^5 , 13×10^5 , 10×10^5 , 7×10^5 and 10×10^3 /gm in time of inoculation, 1,2,3,4,5,6,7 and 14 days respectively. The results indicated that the counts of *Salmonella typhimurium* during this storage increased slowly then decreased in number which show more or less close agreement with observations of (GOEPFERT and CHUNG, 1970 and RICHARD, 1985). SMITH *et al.* (1975) noted in a variety of foods that *Salmonellae* are able to survive but do not multiply at 5°C.

The counts of *Salmonella typhimurium* organisms in minced meat held at -20°C were 12×10^5 , 4×10^5 , 1×10^5 , 5×10^4 , 2×10^4 and 10×10^3 /gm in time of inoculation, 1,2,3,4, and 5 weeks respectively. Similar observation were recorded by GOEPFERT and CHUNG (1970) who stated that the *Salmonellae* decreased in number in the intact sausages held under refrigeration.

Grilling was done on coke fire for 15-20 minutes with maximum internal temperature 70-80°C. After grilling *Salmonella typhimurium* organisms were completely destroyed, these results were in accordance with the results obtained from (PALUMBO

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et al., 1974; BERNARD et al., 1976; SMITH et al., 1977; GOODFELLOW and BROWN, 1978; MASTERS et al., 1981; YOUSSEF, 1981 and WRIGH-RUDOLPH et al., 1986). YOUSSEF and EL-TIMAWY (1982) observed that Salmonellae were completely destroyed when minced meat is subjected for a temperature higher than 70°C.

The presence of Salmonellae in finished frankfurters would indicate either insufficient heating or recontamination after processing (PALUMBO et al., 1974).

The fate of Salmonella in minced meat was affected by a combination of three factors: a- The processing time/temperature. b- The level of Salmonella contamination present. c- Possibly the particular serotype of Salmonella present as a contaminant.

In conclusion, the results presented in this study indicated that Salmonella typhimurium increased in minced meat held at 20-25°C (room temp.) and could be regarded as a public health a hazard. Salmonella typhimurium can grow to high and hazardous level in minced meat stored above 4°C in the first days then decreased in number in prolonged time.

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Table (1)
Salmonella typhimurium counts of stored minced meat at different temperatures.

Hours/20-25 °C					Days/ 4 °C										Weeks/ -20 °C					
0	12	24	36	48	0	1	2	3	4	5	6	7	14	0	1	2	3	4	5	
12×10^5	16×10^5	1×10^7	11×10^7	2×10^8	12×10^5	10×10^5	9×10^5	9×10^5	9×10^5	11×10^5	13×10^5	10×10^5	7×10^5	10×10^3	12×10^5	4×10^5	1×10^5	9×10^4	2×10^4	10×10^3