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# INVESTIGATION OF *Salmonella* spp IN RETAIL RAW MEAT IN SYRIA

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## ABSTRACT

This study was carried out to determine the prevalence of *Salmonella* spp. in retail raw meats commonly sold in the marketplace in Syria. Four hundred samples of retail raw meats (poultry, beef, sheep, and ground meat) from different provinces of Syria were examined for the presence of *Salmonella* spp. by using conventional culture, biochemical and serological methods for *Salmonella* species. The results indicate to present *Salmonella* spp. in (32%) raw poultry samples, (28%) raw beef samples, (15%) raw sheep samples, and in (9%) ground meat samples. In conclusion the present of *Salmonella* spp. in (21%) samples may indicate to the control measures and practices implemented along the chain from primary production to final preparation of the meat for consumption in Syria.
**Keywords:** *Salmonella*, retail meat, Syria.

## INTRODUCTION

*Salmonella* is one of the most important pathogenic genera implicated in foodborne bacterial outbreaks that include nausea, vomiting, septicemia and diarrhea, each year millions of cases occur, most of these infections cause mild illness, severe infections and serious complications-including death (Fratamico *et al.,* 2005).

Infected meat and meat products are among the most important sources of foodborne outbreaks in humans. *Salmonella* organisms are causing major bacterial problems in meat producing companies in the world. These foodborne pathogens can be presented in the gastrointestinal tract of food-producing animals. The most frequent chain of events leading to meat borne illness involves food animals as healthy carriers of the pathogens; these organisms are subsequently transferred to humans through production, handling and consumption of meat and meat products (Norrung and Buncic., 2008).

There have been some reports on the incidence of *Salmonella* in food, in Spain (Capita *et al.,* 2003), in Northern Ireland (Madden *et al* 2001), in England (Jorgensen *et al.*, 2002), in USA (Cason *et al.*, 1997), in Nigeria (Adetunji and Isola ., 2011), in Turkey the prevalence of *salmonella* in meat has been determined by Aydin *et al.*, (2006) , Cetinkaya *et al.*, (2008) and Goncagul *et al.*, (2005), but their incidence in Syria has not been investigated.

Therefore the present study was undertaken to enhance food safety and fill some of the knowledge gaps in the epidemiology of *Salmonella* .This study was to investigate the prevalence of *Salmonella* spp. in raw meat samples commonly sold in the marketplace in Syria.

## MATERIALS AND METHODS

Due to the lack of recent information about the prevalence of *salmonella* in retail raw meat in Syria, we assumed for large sampling procedures an infection prevalence of 50%. Sample size calculation was based upon this prevalence, accepting desired absolute precision of 5% and a level of confidence of 95%. Consequently four hundred raw meat samples were tested to judge this prevalence estimation (Thrusfield, 1997).

Meat samples were collected randomly at intervals between February 2009 and January 2010. A total of 400 meat samples (100 raw beef, 100 raw sheep, 100 raw poultry and 100 ground meat) were collected from producers and retailers in different provinces in Syria.

During samples collection covering carcasses were rarely observed. Further, the chopping blocks of wood were observed to be the same everyday without proper cleanliness, raw meat available in open – air local retail shops without appropriate temperature control was purchased by approximately 18 % household.

All samples were collected in sterile jars and immediately transferred to the laboratory in cold boxes at 4 °C.

To isolation the *Salmonella* spp. pre-enrichment was done by suspending 25 g of sample in 225 ml buffered peptone water (BPW) followed by incubation at 37°C for 16-20 h. 0,1 ml mixture was transferred to Rappaport-Vassiliadis (RV) and Muller KaufmannTetrathionate Broth (MKTTn). MKTTn and RV broth was incubated for 24h at 42°C. After incubation samples were streaked on Hectoen Enteric (HE) Agar and XLD Agar, incubated for 24h at 35°C. The typical colonies were identified by Triple Sugar Iron Agar (TSI), Lysin Iron Agar (LIA), urease test and confirmed with *Salmonella* antiserum (O and H-VI polyvalent antiserum) according to the method of Harrigan (1998).

To determinate (cfu/g) of *Salmonella* a gram of the raw meat sample was inoculated in 9 ml of peptone water in a capped specimen bottle shaken vigorously and incubated overnight. After a ten-fold serial dilution, 1ml of each dilutions were cultured on previously agar plates in triplicates (Harrigan.,1998).

## RESULTS

A total of 400 raw meat and meat products was examined. *Salmonella* spp. was detected in 84 meat samples (21%). According to the results from this study, the highest rates of *Salmonella* spp. were detected in raw poultry samples (32%), in raw beef samples (28%), in raw sheep samples (15%), and in ground meat samples (9%) as shown in table (1). The mean bacterial count in meat samples are shown in table (1) with total counts ranging from $4 \times 10^4$ CFU/g in poultry, $8 \times 10^3$ in beef, $2 \times 10^3$ in sheep and $7 \times 10^2$ in ground meat.

**Table 1: Counts of *Salmonella spp* from Meat Samples**

| Meat sample | Range of *Salmonella* count (CFU/g) | | Mean *Salmonella* count (cfu/g) | Positive percentage |
|---|---|---|---|---|
| | Maximam | Minimam | | |
| poultry | $5 \times 10^5$ | $2 \times 10^3$ | $4 \times 10^4$ | 32% |
| sheep | $7 \times 10^3$ | $2 \times 10^2$ | $2 \times 10^3$ | 15% |
| beef | $6 \times 10^4$ | $3 \times 10^3$ | $8 \times 10^3$ | 28% |
| ground meat | $2 \times 10^3$ | $4 \times 10^2$ | $7 \times 10^2$ | 9% |

The results indicated the highest rates of *Salmonella* in Der Alzor province (26.25 %) which have the highest temperature values as shown in table (2). Seasonally, the prevalence of *Salmonella* spp. infection in retail raw meat reached highest level in July (36 %), while reached the lowest level in January (14.5%).

## DISCUSSION

The present study demonstrated that retail raw meat samples in Syria were heavily contaminated with *Salmonella* spp. (21%). This high level of contamination indicates a potential breakdown of hygiene at various stages of the food processing and distribution chain of meat. According to Syria Food Codex (1996), the presence of *Salmonella* spp. in 25 g of raw meat and meat products is not acceptable.

**Table 2: Incidence of *Salmonella* spp. in various meat samples in different provinces**

| Provinces | Type of Meat | Number of Samples | *Salmonella* spp. positive | Total positive |
|---|---|---|---|---|
| Deraa | Poultry Meat | 20 | 5 (25 %) | 12/80 (15 %) |
| | Beef Meat | 20 | 4 (20 %) | |
| | Sheep Meat | 20 | 2 (10 %) | |
| | Ground Beef | 20 | 1 (5 %) | |
| Damascus | Poultry Meat | 20 | 6 (30 %) | 16/80 (20 %) |
| | Beef Meat | 20 | 5 (25 %) | |
| | Sheep Meat | 20 | 3 (15 %) | |
| | Ground Beef | 20 | 2 (10 %) | |
| Homs | Poultry Meat | 20 | 7 (35 %) | 18/80 (22.5 %) |
| | Beef Meat | 20 | 6 (30 %) | |
| | Sheep Meat | 20 | 3 (15 %) | |
| | Ground Beef | 20 | 2 (10 %) | |
| Aleppo | Poultry Meat | 20 | 6 (30 %) | 17/ 80 (21.25 %) |
| | Beef Meat | 20 | 6 (30%) | |
| | Sheep Meat | 20 | 3 (15%) | |
| | Ground Beef | 20 | 2 (10 %) | |
| Der Alzor | Poultry Meat | 20 | 8 (40 %) | 21/80 (26.25 %) |
| | Beef Meat | 20 | 7 (35%) | |
| | Sheep Meat | 20 | 4 (20%) | |
| | Ground Beef | 20 | 2 (10%) | |

According to the results from this study, the highest rates of *Salmonella* spp have been detected the provinces which have the highest temperatures (Der Alzor 26.25 %) and the highest rates of *Salmonella* spp

have been detected in July (36 %) this may indicate to lack of refrigeration condition of the meat. Temperature is being considered as the most critical factor for the microbial quality of meat at the stage of manufacture, distribution and consumption. Microbial growth is seen to mainly parallel with temperature increase (Harrigan *et al.,* 2006).

We have found the levels of *Salmonella* contamination in raw poultry meat samples was much higher (32%) and total *Salmonella* count (cfu/g) was $4 \times 10^4$ , this may be due to manually broilers killing, this included cutting the carotid artery and jugular vein, followed by scalding, feathering, eviscerating. Contamination of equipment, hands of workers can spread *Salmonella* to uncontaminated carcasses, which can occur during processing, transport and preparation for consumption. The presence of *Salmonella* spp in meat has been widely reported from different parts of the world. Studies concerning chicken, were reported from the USA, where 20% of the 210 chicken samples (Cason *et al.,* 1997), from England where 25 % of the 241 chicken samples (Jorgensen *et al.,* 2002), from South Africa where 19% of the 99 chicken samples (Nierop *et al.,* 2005), from Spain 55 % of the 40 chicken samples (Capita *et al* ., 2003), from Brazil where 11 % of the 288 chicken samples (Cortez *et al.,* 2006) were contaminated with *Salmonella* spp. From Turkey Cetinkaya *et al.,* (2008), Goncagül *et al.*, (2005) and Elmali and Yaman (2005) reported the 0.5%, 8.57% and 36 % occurrence rate of *Salmonella* respectively. Poultry products are frequently contaminated with *Salmonella* shop and are consequently thought to be major sources of the pathogen in humans. Our findings in this study showed similarity with this idea as the frequency of isolation of *Salmonella* spp from poultry samples is higher than the other raw meat and meat products.

Our findings showed that ground meat samples (9 %) were positive for *Salmonella* spp. this was much higher than those reported by Gokalp *et al (*1982) in neighboring country in Turkey where 2 % of ground beef meat samples were positive to *Salmonella spp.* Contrary to this, El-Leithy and Rashad (1989) did the study in Turkey which has higher results (15 %) than ours.

In the present study, of the analyzed 100 raw sheep meat and 100 raw beef meat samples 15 % and 28% were positive for *Salmonella* spp. respectively. In Northern Ireland 1.5% of 200 (Madden *et al.,* 2001) and in Australia 0.22% of 1063 (Vanderlinde *et al.,* 1998) beef samples were investigated *Salmonella* spp. contamination. In Turkey, 4% of the 100 sheep samples were detected positive (Kahraman *et al.,* 2005). In Abidjan 27% of the 27 beef samples were detected positive (Nevry *et al.,* 2011). Overall, a major survey of the *Salmonella* spp. on 1117 sheep samples found none in Australian sheep (Phillips *et al.,* 2006).

Observations showed heavy *Salmonella* loads carried by meat. The presence of a high number of *Salmonella* spp. are an indicator of the expected shelf life of meat and increases the chances of meat spoilage in a short time. This study presents the contamination status of retail meat and its surrounding environment and evaluates that most of the retail shops didn't operate in a safe and sanitized environment. Covering carcasses were rarely observed. Further, the chopping blocks of wood were found to be the same

everyday without proper cleanliness, this enhanced the chances of cross contamination of uninfected carcass if any prior carcass happens to be infected. The processing of carcass surface into parts further spreads contamination by exposing more carcass surface and susceptible fleshy parts to the contaminations if the same cutting blocks and knives are used. Therefore it is important to ensure the practice of WHO basic hygiene principles, which cover food safety procedures from the farm of origin, to ante-mortem and post-mortem inspection, to handling until the food is consumed (Notermans *et al.,* 1995).

Knowledge of how *Salmonella* disseminates through the food chain is important in understanding how food animals and food processing procedures contribute to food contamination and subsequent human infections. The lack of food hygiene also needs to be addressed and it is necessary to pay more attention to reduce or eliminate the risk from pathogenic bacteria originating from food, the scientific community should join regulatory authorities to spread awareness about basic hygiene principles. It is especially important to provide training for meat handlers regarding food safety.

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## CONCLUSION

In conclusion, the results indicate that meat presents a potential hazard to public health. Therefore, it is essential to ensure improved the quality of production technology and developing the sanitation strategies for controlling foodborne pathogens and enhancing the safety of food.

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## التحري عن السالمونيلا في اللحوم النيئة المباعة في سورية

**ســـــــاجـــد حســـــن**
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أجريت هذه الدراسة لتحديد نسبة انتشار بكتريا السالمونيلا في اللحوم النيئة المباعة في الأسواق السورية ولذلك تم جمع ٤٠٠ عينة من اللحوم النيئة ( دجاج – عجل – ضأن– لحوم مفرومة ) من عدة محافظات سورية بطريقة عشوائية وفحصت هذه العينات بطرق الزرع التقليدي كما استخدمت الطرق البيوكيمائية والمصلية للكشف عن الأنواع المختلفة للسالمونيلا. أشارت النتائج إلى وجود بكتيريا السالمونيلا بنسبة (٣٢%) في عينات لحوم الدواجن و (٢٨%) في عينات لحوم العجل و (١٥%) في عينات لحوم الضأن و (٩%) في عينات اللحوم المفرومة , وفي النتيجة فان وجود بكتريا السالمونيلا بنسبة (٢١%) من العينات يمكن أن يشير إلى تطبيقات وإجراءات التحكم المطبقة على اللحوم المستهلكة في سورية عبر السلسلة الممتدة من بداية الإنتاج حتى التحضير النهائي .

**قام بتحكيم البحث**

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