Original article

Prevalence and antimicrobial resistance of *Salmonella* spp. from mutton meat in Khartoum State, Sudan

*Rayan Mohammed Abdalbage [1], Hassan Elsiddig Hag Elsafi [*2], Shahinaz Fadul Mohammed [1]*

1. Department of Food Safety and Veterinary Public Health, College of Veterinary Medicine, University of Bahri, Khartoum North, Sudan.
2. Ahfad Centre for Science and Technology, Ahfad University for Women, Omdurman, Sudan.

A R T I C L E   I N F O

A B S T R A C T

Background: Salmonellosis is a significant food-borne zoonosis and public health issue worldwide. Retail meat is considered as one of the major sources of *Salmonella*. However, data about the prevalence of *Salmonella* from mutton meat in Sudan are insufficient. **Methods**: This cross sectional study was undertaken to determine the prevalence and antimicrobial resistance of *Salmonella* spp. from mutton meat carcasses at butcher shops in Khartoum State, Sudan between February-December 2021. **Results:** Overall, *Salmonella* spp. was isolated from 6 samples out of 500 (1.2%). All recovered isolates were sensitive to amikacin, cefotaxime and co-trimoxazole (100%), and 4 (66.6%) were resistant to ampicillin, 1 (16.6%) to cefuroxime and 1 (16.6%) to tetracycline. None of the isolates showed multiple drug resistance (MDR). **Conclusions**: Our findings showed low prevalence of *Salmonella* in mutton meat in Khartoum State, and exhibited resistance to some antimicrobial agents. However, control measures should not be neglected to avoid contamination with food-borne pathogens.

Introduction

Salmonella is one of the common pathogens causing sporadic cases or outbreaks of gastroenteritis [1]. Food borne illnesses pose public health and economic burdens both in developed and developing countries [2,3]. Food from animal origin is an important source of *Salmonella* infections in humans [4]. *Salmonella* live in the gastrointestinal tracts of domestic and wild animals [5]. More than 2,600 serotypes of *Salmonella* have been identified [6]. Based on the clinical profiles of infections caused in humans *S. enterica* can be divided into typhoidal which are human specific and non typhoidal *Salmonella* (NTS) having a broad host range [7]. The global incidence of diarrheal disease duo to the NTS account for about 94 million enteric infections each year, of which 80.3 million cases are considered food borne and resulting in 155,000 human deaths annually [8].

Salmonella infection has been associated with symptoms ranging from mild self-limiting gastroenteritis characterized by diarrhea, abdominal pain and vomiting in people of all ages to severe invasive diseases with complicated extra-intestinal illness, bacteremia and meningitis in children, elderly and immunocompromized patients [9]. However, in small percentage of *Salmonella* infections, the

diarrhea may be so severe that patient needs to be hospitalized. In these patients, the *Salmonella* infection may spread from the intestine to the blood stream, to other body sites, resulting in death unless promptly treated with antibiotics [10].

During processing of meat, animal gut microbiota and associated pathogens from the caecum, intestines, or feces may be transferred directly to the carcass or meat. Transfer may also be indirect, such as from human hands and equipment. Both pathways may result in transfer of gastro-intestinal flora to meat. Such transfer is associated with increased risk for human infection from consumption of contaminated meat and cross-contamination of other food [11].

Historically, most studies on the prevalence and characterization of the antimicrobial resistance of *Salmonella* have been restricted to isolation from clinical and/or veterinary sources [12]. Antimicrobial agents such as fluoroquinolone and third-generation cephalosporins are commonly used to treat severe human *Salmonella* infections [13]. Resistance to antimicrobials has increased over the last decades, probably as a consequence of intensive use of antimicrobial agents in animal husbandry and medicine [14]. Antimicrobial resistant strains of *Salmonella* species are now widespread all over the world. In developed countries it has become more and more accepted that a majority of resistant strains are of zoonotic origin and have acquired their resistance in an animal host before being transmitted to human through the food chain [15]. The spread of antimicrobial resistance through the food chain is regarded as a major public health issue [16].

There are limited studies in Sudan about the spread of *Salmonella* in mutton meat, but different studies were conducted in *Salmonella* from poultry and beef meat. So this study is designed to fill the knowledge gap in the area.

This study was conducted to determine prevalence and antimicrobial resistance of *Salmonella* spp. from mutton meat in Khartoum State.

Material and Methods

Collection of samples
This cross–sectional study was conducted on mutton meat carcasses at butcher shops from Khartoum State (Khartoum, Khartoum North and Omdurman), between February and December 2021. A total of 500 mutton meat swabs from carcasses were collected. Each sample was kept under hygienic conditions and transferred in ice-box to the microbiology laboratory at Ahfad University for Women as soon as possible.

Isolation and identification
Salmonella isolation and identification were performed according to ISO 6579-1 [17], with some modifications. Each swab was pre-enriched in 9 ml of Buffered Peptone Water (BPW) (HiMedia, India) and incubated at 37°C for 24h, then 0.1 ml of each overnight culture was inoculated into 10 ml of selective enrichment medium, Rappaport-Vassiliadis Soya broth (HiMedia, India) and incubated at 42°C for 24h, A loop-full was streaked onto XLD agar (Xylose Lysine Desoxycholate agar) (HiMedia, India), incubated for 24h at 37°C. Suspected *Salmonella* colonies with pink black centers were subjected to biochemical tests including urease activity, indole production, lysine decarboxylase activity and growth on triple sugar iron agar (TSI agar) [17].

Antimicrobial susceptibility testing
The antimicrobial susceptibility of *Salmonella* isolates was evaluated by disc diffusion method according to Clinical Laboratory Standard Institute guidelines [18]. The isolates were tested against 6 antimicrobial agents from different antimicrobial groups such as amikacin (30 mcg), ampicillin (10 mcg), cefuroxime (30 mcg), cefotaxime (30 mcg), co-trimoxazole (25 mcg) and tetracycline (30 mcg).

Results
A total of 6 *Salmonella* isolates out of 500 samples were recovered, representing a prevalence of 1.2% in mutton meat in Khartoum State. Regarding antimicrobial susceptibility testing all 6 isolates were sensitive to amikacin, cefotaxime and co-trimoxazole (100%), and 4 (66.6%) were resistant to ampicillin, 1 (16.6%) to cefuroxime and 1 (16.6%) to tetracycline, respectively **(Table 1)** and **(Figure 1)**. None of the recovered isolates showed multi-drug resistance

Table 1. Antibiogram sensitivity/ resistance pattern of *Salmonella* isolates

Name	Resistance		Intermediate		Sensitive	
	No	%	No	%	No	%
Amikacin	0	0 %	0	0%	6	100 %
Ampicillin	4	66.6 %	2	33.3 %	0	0 %
Cefuroxime	1	16.6 %	0	0 %	5	83.3 %
Cefotaxime	0	0 %	0	0 %	6	100 %
Co-Trimoxazole	0	0 %	0	0 %	6	100 %
Tetracycline	1	16.6 %	0	0 %	5	83.3 %

Figure 1. Percentage of resistance in *Salmonella* isolates
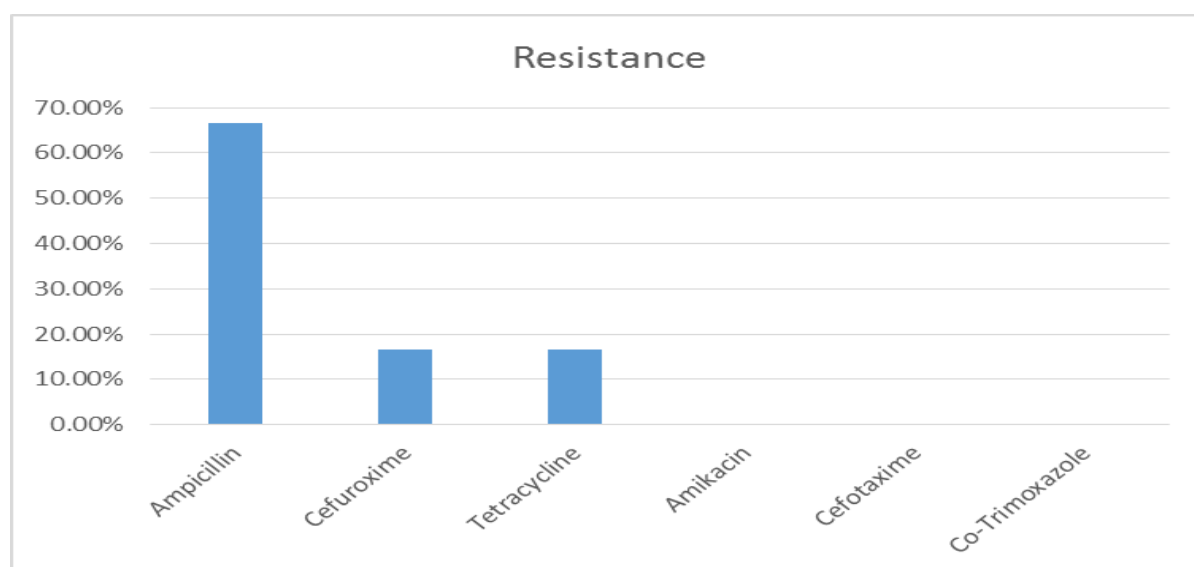
Discussion

This study showed that the prevalence rate of *Salmonella* from mutton carcasses was 1.2% (6/500). This result is in accordance with 1.2% prevalence from mutton meat in Ethiopia [19]. While, our findings are less than 14.1% and 9.9% from Addis Ababa, Ethiopia [20, 21]. It is less than 60.2 % from hind of sheep in Riyadh, Saudi Arabia [22], and less than 10% reported from freshly dressed carcass in Spain [23] and 4% from on Hyderabad, India [24]. Also less than 33.3% prevalence in China [25]. The low prevalence of *Salmonella* may be a result of dealing in a hygienic way in butchers' shops.

In this study all isolates were sensitive to amikacin, cefotaxime and co-trimoxazole while four isolates (66.6%) were resistant to ampicillin. one isolate (16.6%) was resistant to cefuroxime and another isolate (16.6%) is resistant to tetracycline. Isolates in this study showed higher resistance to ampicillin and tetracycline compared to the results of **Yan et al.** [25] that showed resistance to ampicillin and tetracycline are (0%) but our findings showed less resistance to co-trimoxazole (0%) compared to the 6.7% of **Yan et al.** [25]. This study showed there is no multiple drug resistance, while, **Manafi et al**. [26] found MDR in 30% of *Salmonella* isolates from mutton meat. High resistance to ampicillin and tetracycline can be attributed to their extensive use in livestock. In Sudan, amikacin and cefotaxime are not used in livestock so this can explain their high rate of susceptibility (100%). Also co-trimoxazole showed 100% susceptibility which is used to less extent in animal husbandry.

Conclusion

This study showed that mutton meat is contaminated with *Salmonella* spp. from butchers' shops in Khartoum State. Some isolates showed resistance to some antimicrobial agents. The findings of this study can be used as starting point for further investigations regarding the prevalence and antimicrobial resistance of *Salmonella* isolated from mutton meat and food of animal origin to develop regulations to reduce the risk food-borne

pathogens, as well as for further surveillance programs.

Conflicts of interest : None.

Financial disclosure : None

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