Microbial Load on Beef at Some Butcheries in Alhaj-Yousef Area, Khartoum State: A Short Communication

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Abstract: Microbial contamination on beef meat can be influenced by many factors during slaughtering and handling before the meat is finally ready-to-eat. The current study was conducted to investigate bacteria that can be encountered in contamination of beef in 4 small butcheries in Alhaj Yousif area, Khartoum state, the Sudan. Eighty swab samples were collected from meat, butchers' hands, and surfaces of tables, cutting boards, and knives. The total viable count (TVC) of the contaminating bacteria was preformed as well as isolation and identification. The results revealed no statistically significant difference between the TVCs reported from the meat, butchers' hands, and surfaces of tables, cutting boards, and knives and were between 5.23 ± 0.03 and 5.32 ± 0.07 $\log_{10}$ cfu/cm^{-2} or g. *E. coli* was found in 52.5% (n=42) of the samples and *Salmonella* species in 53.8% (n=43). In conclusion, the reported TVC levels were higher than the acceptable and raising the awareness of the butchers on food safety issues is highly recommended.
Keywords: bacteria, beef, butcheries, Alhaj-Yousef, Khartoum state

INTRODUCTION

Meat is an important component of human diet as it contains many essential elements for normal health [1, 2]. Hence, many bacteria like *Bacillus cereus*, *Campylobacter* species, *Clostridium botulinum*, *Clostridium perfringens*, entero-pathogneic *Escherichia coli*, *Salmonella* species, *Shigella* species, *Staphylococcus aureus* and *Yersinia enterocolitica* can propagate in meat posing a great risk of infection or poisoning for consumers [2-4].

Sources of bacterial contamination of meat are many and it can probably originate from the slaughtered animal itself and/or from the processing and vending environments [5, 6]. Retail meats are often associated with direct hand-to-mouth exposure to enteric pathogens and cross-contamination in the kitchen [3]. However, if the Hazard Analysis Critical Control Point (HACCP) is strictly applied at certain Critical Control Points (CCPs) on the production line from slaughtering to butcheries and kitchens as a preventive approach, the safety of the meat can be ensured [4, 7].

In the Sudan, hygienic measures to control microbial contamination of meat are in most cases inadequate [6]. Refrigeration of meat at 4°C is among the most effective practices for improving the safety of fresh meat [4]. This habit is not practiced in butcheries in the Sudan but rather carcasses meats are hanged in the ambient temperature and left exposed to environmental pollution for long time. This study was carried out to determine the bacterial load on beef and to investigate the percentage of contamination with *E. coli* and *Salmonella* species in Alhaj-Yousef area, Khartoum state, the Sudan.

MATERIALS AND METHODS
Sampling method

A total number of 80 swabs samples were collected from 4 butcheries in Alhaj-Yousef area, Sharg-Alneeyl locality, Khartoum state, the Sudan. The swab samples were taken from 4 critical control points (CCPs) which were 40 meat, 10 butchers' hands, surfaces of 20 tables and meat cutting boards and 10 knife. The swabs were labeled, stored in an ice box, and transferred to the Microbiology Laboratory of Collage of Veterinary Medicine, Sudan University of Science and Technology, where were all cultured during the same day.

Laboratory procedures

The total viable count (TVC) and *E. coli* and *Salmonella* species isolation and identification were conducted following the standard procedures described by Barrow and Feltham [8].

Statistical analyses

Data analyses were done using the Statistical Package for the Social Sciences (SPSS) software version 20.0, Chicago, IL, USA. Descriptive statistics including frequencies and percentages were first computed. In addition, TVCs were converted to $\log_{10}$ and means of $\log_{10}$ cfu/cm^2 or g were calculated and compared with each other by using ANOVA.

RESULTS

The levels of the TVCs obtained from meat, hand of butchers, and surfaces of tables, meat cutting boards and knives were not statistically different at p-value (p≤ 0.05) and were between 5.23±0.03 and 5.32±0.07 $\log_{10}$ cfu/cm^{-2} or g with a df of 3 and 0.613 estimated p-value between CCPs and within CCPs (Fig. 1). The TVCs levels between the 4 butcheries

were the same as reported from the 4 different CCPs with a p-value of 0.188 for between butcheries and within butcheries variations (Fig. 2).

Characters and biochemical reactions including Gram stain, growth on MacConkey agar, DCA, and KIA and oxidase, motility, Indole citrate, urease, H$_2$S and gas production of the isolates detected in this study are shown in Table 1.

Species identification led to the detection of *E. coli* in 52.5% (n=42) and *Salmonella* species in 53.8% (n=43) of all samples (Table 2). The tow bacteria were most detected, 25.0% and 30.0%, respectively, in samples of meat. Furthermore, they were also isolated from hand of butchers, knives, and surfaces.
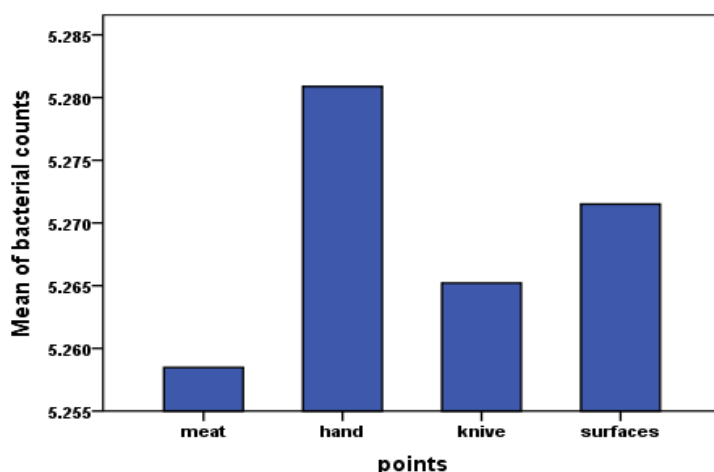

Fig-1: The total viable counts ($\log_{10}$ cfu/cm^2 or g) of the Bacteria Found in the Four investigated CCPs at the 4 butcheries in Alhaj-Yousef area, Sharg-Alneeyl locality, Khartoum state

Fig-2: The total viable counts ($\log_{10}$ cfu/cm^2 or g) of the Bacteria Found in the Four investigated CCPs and the 4 butcheries in Alhaj-Yousef area, Sharg-Alneeyl locality, Khartoum state
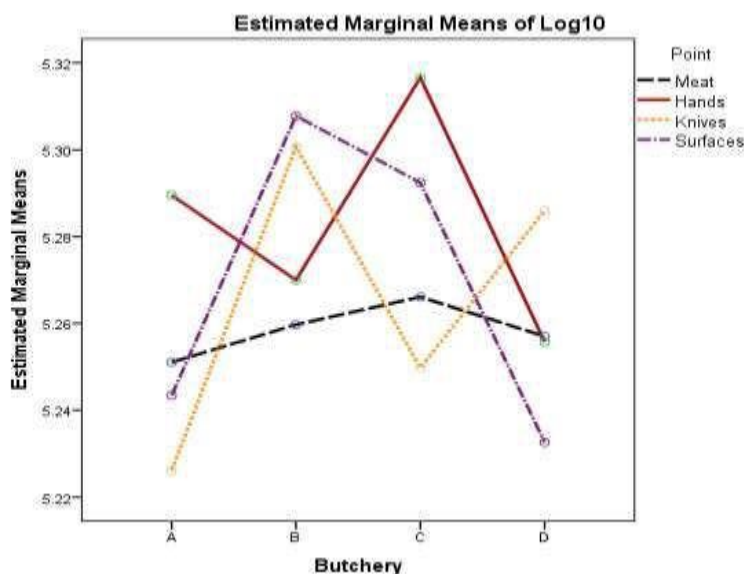
Table 1: Characters and biochemical reactions of the isolated *E. coli* and *Salmonella* spp. strains from the different CCPs at the 4 butcheries in Alhaj-Yousef area, Sharg-Alneeyl locality, Khartoum state

Test	*E. coli*	*Salmonella* spp.
Gram stain	-	-
MacConkey agar	+	-
DCA	-	+
Oxidase	-	-
Motility	+	+
Indole	+	-
Citrate	-	+
Urease	-	-
KIA	yellow butt yellow slop	yellow butt red slop
H₂S	-	+
Gas	+	+

Table 2: Number of *E. coli* and *Salmonella* spp. isolated from the different CCPs at the 4 butcheries in Alhaj-Yousef area, Sharg-Alneeyl locality, Khartoum state

Points	no. tested	*E. coli*	%	*Salmonella* spp.	%
Meat	40	20	25.0	24	30.0
Hands	10	5	6.25	5	6.20
Knives	10	4	5.00	7	8.80
Surfaces	20	13	16.2	7	8.80
Total	80	42	52.5	43	53.8

DISCUSSION

Several unwanted human health-related consequences ranging from mild to severe disease symptoms and death can occur as result of eating of meat contaminated with pathogenic bacteria [9, 10]. Meat contamination can occur at any CCPs along the production chain including in butcheries. The microflora of meats available to consumers is the total sum of microorganisms acquired during processing of animal carcasses. Animal health, dressing skills, personnel hygiene, cleanliness of slaughterhouses and butcher shops, and adequate storage and holding temperature during distribution and retail vending are all factors that influence the constitution and number of microorganisms on the meat [11].

The levels of the TVCs obtained from meat, hands of butchers, knives, and surfaces of tables and meat cutting boards from the 4 investigated butcheries were not statistically different and were higher than the acceptable level. Ali *et al.* [12] reported total aerobic counts that ranged from 10^8 to 10^{10} cfu/g or cm^2 whereas Bogere and Baluka [10] reported a cfu per g of 1.92×10^9 of APCs from meat. Additionally, Ali *et al* [12] reported log of cfu per every g or cm^2 that was ranging from 7.5 to 10.2 from retail meat and surfaces of meat cutting equipments including knives, weighing scales, wooden boards, and meat mincer.

In this study, *E. coli* and *Salmonella* species were detected in half of the investigated samples. This was similar to the findings of Collins [13] who isolated Gram positive and Gram negative bacteria from meat products. Furthermore, Bogere and Baluka [10] found very high frequencies of more than 80% for APCs, coliforms, *E. coli* and *S. aureus*, and Ali *et al.* [12] found out that 84% were contaminated with bacterial species. Also, Zhao *et al.* [3] were able to isolate *E. coli* and *Salmonella* species from beef in retail shops from 19.0% (n=40) and 1.9% (n=4), respectively. Another interesting finding was that all of the meat samples (100%) showed growths of aerobic bacteria including 93.8% coliform, 83.3% *E. coli*, and 4.2% *Salmonella* species in Uganda [10]. In addition, Ali *et al.* [12] detected *E. coli* and *E. coli* O157:H7 in 35% (n=120) and 15% (n=51) meat samples and *E. coli* on swabs taken from surfaces was found in 24% (n=50) of the samples, besides *Salmonella* species from 7% (n=24) of the meat samples.

The hygienic situation of butcheries in Alhaj-Yousef area, Khartoum state, was identical to the one observed by Bogere and Baluka [10] in Uganda and was not in accordance with butchers HACCP or what is known as the "safe food handling for butchers". Briefly, the main observations were that butchers were not wearing the standard cloths, the floor of the butcheries was not concrete, stray cats and dogs were moving freely in/out and around the butcheries, the environment of putting the meat on show for customers was not clean and there was no water supply for hands and knives washing, there was no fridges for meat storing or even cooling system for the butchery, flies were swarming around in the butcheries, and money was received with the same hand used for holding the meat while weighing. The high TVCs reported in this study and prevalence of *E. coli* and Salmonella species could possibly be due to all these observations.

CONCLUSION AND RECOMMENDATIONS

It can be concluded that the TVC levels in the investigated butcheries in Alhaj-Yousef area, Khartoum state were higher than the acceptable levels besides to the presence of *E. coli* and *Salmonella* species. On the other hand, improving the construction of the butcheries and raising the awareness of the butchers on food safety issues are highly recommended.

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