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Research Article

Determination of the Bacterial Contamination of fresh Camel Meat (*Camelus dromedarius*) in Tambool Town Slaughter-House, Sudan, 2014

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ABSTRACT

This study was conducted to determine bacterial contamination of camel carcasses at Tambool slaughterhouse, from October to December 2014. A total of 150 swab samples were collected for total viable counts (TVCs) of bacteria from 10 camel carcasses. These carcasses were randomly selected and sampled from different sites: (shoulder, rump, neck and brisket) in addition to the workers hands at the point of skinning, evisceration and washing; also, worker's knives were sampled at the moment of skinning, evisceration, using sterile swabs. The TVC ranged from 12×10^3cfu/ml to 1, 2×10^3cfu/ml. The highest level of TVC after skinning was from the neck site 12×10^3 cfu/ml, while it was from the brisket 5.4×10^3 cfu/ml after evisceration and was from the neck $3{,}1\times10^3$ cfu/ml after washing. Eleven species of bacteria were isolated and the highest average prevalence was Pseudomonas spp. (18.69%) and the lowest average was Salmonella spp. (1.62%).

Key words: Prevalence, Slaughterhouse, Pseudomonas spp, Salmonella spp, Carcasses

INTRODUCTION

Animal resources in the Sudan comprise of sheep, goat, cattle, camel, poultry and wild-game. Establishing a hygienic program for exported meat is required in order to enable the Sudan fulfill the international trade parameters, this entails a vital need to improve the slaughter-houses and to impose strict hygienic measures to provide wholesome meat to fulfill the international requirements (International Committee of Microbiological Standards of Foods (ICMSF), 1996; Gracey *et al*., 1994).Tambool town the bight market of camel meat in Sudan, is one of the famous towns in AlGazera State, it is located in the eastern part of AlGazera State, near to Rufaa town-35Kilometers approximately (map). Camel is one of the most fundamental pillars of the national economy and food security for many countries in the world, it can provide a substantial amount of high quality meat. The demand for camel meat appears to be increasing due to health reasons, as they produce meat with less fat as well as having less cholesterol and relatively high polyunsaturated fatty acids than other animal's meat (Elgasim *et al*., 1987; El-Faer *et al.*, 1991; Elgasim and Alkanhal, 1992; Dawood and Alkanhal, 1995).

Meat is one of the highly perishable foods because of its high nutritional contents, enzymatic action and the presence of microorganisms (bacteria, yeasts and molds) which may result in oxidative rancidity, discolouration, mouldiness, off flavour and sliminess. The major source of these deteriorative changes being microorganisms, that renders the meat unacceptable and unfit for human consumption (Ajiboye *et al.*, 2011).

The microbiological contamination of carcasses occurs mainly during processing and manipulation, such as skinning, evisceration, storage and distribution at slaughter-houses and retail establishments (Gill, 1998; Abdalla *et al.*, 2009). Most microbial contaminants of carcasses represented by commensal bacteria, and some microorganisms such as Salmonella spp., Escherichia coliO157::H7 and Listeria monocytogenes, pose a threat to consumer health (Gustavsson and Borch, 1993). There were significant increases in total bacterial counts at

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skinning points than that at washing operations; also, dirty workers hands, clothes and equipment of the slaughterhouse acted as intermediate sources of contamination of meat (Gill, 1998; Gilmour *et al.*, 2004; AbdelSadig, 2006; Abdalla *et al.*, 2009). Ali (2007), recorded high contamination level on flank site and lower contamination level on rump sites during skinning.

In Sudan, hygienic measures to control microbial contamination of meat are unsatisfactorily applied. Storage at refrigerator temperatures is still one of the most effective practices for improving the safety of fresh meat. However, some butcheries still use poor refrigeration, in addition, the retail of raw meat in most of butcheries is presented exposed to environmental pollution which might lead to increased bacterial contamination.

The objectives of this study are to investigate the microbial contamination of camel raw meat, to identify the main points of contamination of camel carcasses during slaughtering operations and to identify the bacterial contamination associated with camel meat in slaughter-houses in Tambool town.

MATERIALS AND METHODS

Area of the study

The study was conducted in Tambool town in Butana region, east of Algazera State and around 150 kilometer southern Khartoum near to Rufaa town (35 Kilometers approximately). Butana area occupies the north-eastern area of Sudan, in area covering over 12000 km^2. It's lies between Latitude 13°50 and 17° 50 north and Longitude 32°40 and 36°00 east, bounded by the Main River Nile on its northwestern border, the Blue Nile on its southwestern edge, the Atbara River in the northeast and by the railway connecting Kassala and Sennar on the south. Tambool town is one of the famous towns in AlGazera State. It is one of the biggest camel markets in Sudan, contains large number of animal species especially camel (*Camelus dromedarius*).

Method of collection of samples

One hundred fifty swab samples were collected, from 10 camel carcasses which were randomly selected, by using sterile swabs from four sites of carcass, namely shoulder, rump, neck and brisket region and from the workers hands, at the time of skinning, evisceration and washing, and also from the workers knives at the moment of skinning, evisceration. The study was conducted to determine bacterial contamination of camel carcasses at slaughterhouses in Tambool town in the period from October to November 2014. Samples were collected for total viable counts (TVCs). After slaughter of animals, Skinning is done manually and then the animals are eviscerates, spray with tap water and washes thoroughly, then left to dry and sent to market.

From each carcass, 4 swab samples were collected from the brisket, shoulder, neck and rump after skinning, evisceration and washing respectively. In addition, 5 swab samples were collected from the workers hands and knives surfaces after skinning, evisceration and washing. The samples were stored in a cooling box and transported to the Microbiology laboratory in the College of Veterinary Medicine, Sudan University of Science and Technology, where the microbiological analysis was performed at the same day.

Method of sterilization

Dry heat

Hot air oven was used for sterilization of clean glass containers which were wrapped in foil or put in stainless steel cans, at a temperature of 160˚C for one hour.

Flaming used to sterilize the mouth of bottles, cotton plugged tubes and glass slides. It was done by exposing the object to the direct flame for about half to one second.

Moist heat

Autoclaving was used for sterilization of media and materials that couldn't withstand the dry heat. The temperature was 115℃-121℃ under 10-15 pounds pressure for 15-20 minutes.

Culture media

Liquid media

Nutrient broth medium: Thirteen grams of the dehydrated medium (Oxoid) were added to 1 liter of distilled water and brought to boiling until dissolved completely. The PH was adjusted to 7.4±0.2. Distributed into test tubes as 5ml volumes, and then sterilized by autoclaving at 121℃ for 15 minutes.

Solid media

Nutrient agar medium: Twenty eight grams of nutrient agar powder (Oxoid) were added to 1 liter of distilled water and brought to boiling until dissolved completely. The PH was adjusted to 7.4±0.2. It was then sterilized by autoclaving at 121℃ for 15 minutes. Then it was aseptically distributed in sterile petri dishes as 15-20ml portions and left to solidify.

Statistical analysis

Data were analyzed using SPSS software (Statistical Package for the Social Sciences, version 16.0, SSPS Inc. And Chicago, IL, USA). All bacterial counts were analyzed and ANOVA method was performed. Statistical significance was set at a P-value of ≤0.05.

Table 1: Total Viable Counts (cfu/ml) from some sites on camel carcasses at different operational points at Tambool slaughterhouse

Sites	Operational points			Significance
	After skinning	After evisceration	After washing	
Brisket	10×10^3	5.4×10^3	1.3×10^3	*
Shoulder	11×10^3	1.4×10^3	1.5×10^3	*
Neck	12×10^3	1.6×10^3	3.1×10^3	*
Rump	9×10^3	1.2×10^3	1.2×10^3	*
Knives	8×10^3	4.7×10^3	ND	*
Hands of workers	7×10^3	3.1×10^3	1.4×10^3	*

*Statistically significant difference at P-value (P≤0.05).

RESULTS

The study revealed a statistically significant difference at P-value ≤0.05 at the different operational points between the samples tested from slaughterhouse after skinning, evisceration and after washing.

As shown in Table 1, the TVC revealed the highest contamination level recorded after skinning was from the neck (12×10³CFU/ML), while the highest contamination level after evisceration was from brisket (5,4×10³ CFU/ML), and the highest contamination level after washing was from the neck (3,1×10³CFU/ML).

The study revealed a statistically significant difference at P-value ≤0.05 at the different operational points between the samples tested from Tambool town slaughterhouse.

Table 2: Summery of the type and parentage of Bacteria isolated from 10 camel carcasses in the Tambool slaughterhouse

Type of organisms	Number of isolates from sampled carcasses	Relative frequency of isolate (%)
Pseudomonas spp.	23	18.69%
Staphylococcus aureus	20	16.26%
Bacillus spp.	17	13.82%
Klebsiella spp.	15	12.19%
Escherichia coli	13	10.56%
Micrococcus spp.	10	8.13%
Pasteurella	9	7.31%
Proteus spp.	6	4.87%
Staphylococcus spp.	5	4.06%
Streptococcus spp.	3	2.43%
Salmonella spp.	2	1.62%
Total	123	100.00

*Eleven (11) species of bacteria were isolated and the highest average prevalence was Pseudomonas spp. 18.69% and the lowest average is Salmonella spp. 1.62%.

DISCUSSION

The level of the TVC is set and agreed to be a criterion for assessing the microbial contamination of carcasses and a useful mean to know the hygienic status of meat (Zweifel and Stephan, 2003). In this study, the TVC ranged from 12×10³ CFU/ML to 1.2×10³CFU/ML at slaughterhouse. Tambool slaughterhouse had showed TVC above the acceptable value of 10 CFU/ML set by Decision 2001/471/EC of the EU Commission (Anonymous, 2001). These findings are higher than those reported by Abdalla *et al.*, (2009), who reported a TVC that ranged from 7,5×10³ CFU/ML to 0,8×10³ CFU/ML and this could be due to multiple contacts of carcasses with contaminated slaughtering utensils and hands of workers (Nouichi and Hamdi, 2009). Moreover, this study also revealed a statistically significant difference (P≤0.05) between after skinning, after evisceration and after washing. This finding is similar to what has been found by Gill (1998) who reported bacterial contamination of meat during the different slaughtering operations stages. The highest level of TVC after skinning was from the neck at the slaughterhouse (12×10³ CFU/ML). This could probably be due to that the neck is the first part of the animal to be exposed to the ambient environment. Interestingly the highest level of TVC after evisceration was from the brisket at the slaughterhouse (5.4×10³ CFU/ML). The possible explanation is that the brisket gets in contact with the viscera more than any other part of the body. In after wash the highest level of TVC was from the neck at the slaughterhouse (3, 1×10³ CFU/ML) and this could be related to that the carcass is normally washed from upper parts. Another possible explanation to the differences of the points of the highest TVC could be due to multiple contacts of carcasses with contaminated slaughtering utensils and hands of workers (Jeffery, 2003; Nouichi and Hamdi, 2009). The comparatively high Enterobacteriaceae count in the examined camel samples is an indication of inadequate sanitation during stages of slaughtering, evisceration, washing, transportation, non-cleaned equipment or improper handling. In general, the Enterobacteriaceae were regularly detected on meat surface (Delhalle, *et al;* 2008).

It was shown in this study that the predominant bacteria isolated were S. aureus, Pseudomonas spp, Bacillus spp and E. coli (Table 2). These micro-organisms can be opportunistic pathogens of humans and were isolated from human clinical specimens of an outbreak of food poisoning (Gracey and Collins¸1994).

Most microbial contaminants of carcasses represent commensal bacteria, some micro-organisms such as Salmonella spp, Escherichia coli O157::H7 and Listeria monocytogenes pose a threat to consumer health (Gustavsson and Borch, 1993; Samelis *et al.*, 2001). The members of the genera pseudomonas, Acinetobacter and Moraxella dominated the bacterial content of un-processed meat exposed to air at chill temperature (Inter National commission for microbiological specification for food – INCMSF, 1980).

The lowest rates of contamination occurred in critical control points were found to be in the skinning while the highest rates of contamination occurred on the carcass in the brisket and the lowest contamination occurred in the carcass surface was observed in the rump.

According to Schutz (1991) the occurrence of hygienic faults and of ahigh level of microbiological contamination of carcasses in slaughterhouses are due, not to an absence of hygiene equipment or to failure to use what equipment there is, but rather to faulty slaughter techniques. The spread of pathogen can also be reduced by developing slaughter techniques, especially the technique of removing tonsils from pigs (Christensen and Luthje, 1994) and of enclosing the rectum (Andersen *et al.*, 1991) has reduced the pathogen contamination.

According to Gerats (1990), there is an association between slaughter technique and the hygienic practice of workers. Those workers who commit many slaughter mistakes neglect hygienic practices. Grats *et al.* (1981) have found an association between the number of Enterobacteriaceae in pig carcasses and hygiene practices connected with slaughter mistakes during evisceration. For a long time, it was through that it is necessary to ingest 105 or more cells of Salmonella per gram of food to cause disease in man. However, studies in recent year found that as low as 3-10 cells/gm can cause disease.

Salmonella typhimurium is more widely distributed than any other serovars, this organism causes severe outbreaks of salmonellosis in all kinds of animals and was frequently the cause of both sporadic cases and outbreaks of gastroenteritis in man all over the world (ICMSF, 1996).

Involving good sanitary measures during slaughtering processes will lead to the reduction of the amount and/or removal of the microorganisms and other hazards. HACCP should be applied properly during slaughtering operations by using sufficient clean water and safe disinfectants. To make all these, extensive education and training programs for workers should immediately be started. In conclusion, this study revealed that the level of contamination on camel carcasses was much higher than the acceptable value set by the EU Commission.

Conclusions

This study reveals that there was contamination of camel fresh meat in Tambool slaughter- house with food spoilage organisms which reduce the quality of meat and pathogenic organisms such as Salmonella Spp, E-coli, which constitute a public health hazard. Food poisoning bacteria such as S. aureus was isolated in most of stages of carcass processing. In Recommendation, each establishment should develop and implements written sanitation standard operating procedures (Sanitation SOP's), regular microbial testing by slaughter establishments must be followed to verify the adequacy of the establishments process controls for the prevention and removal of fecal contamination and associated bacteria, establishment of pathogen reduction performance standards for Salmonella at the slaughterhouse. All meat establishments should develop and implement a system of preventive controls designed to improve the safety of their products, known as HACCP (Hazard Analysis and Critical Control Points).

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