

# Sanitation and Hygiene Meat Handling Practices in Small and Medium Enterprise butcheries in Kenya - Case Study of Nairobi and Isiolo Counties

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## Abstract

In Kenya, meat handling practices among small and medium enterprise (SME) butcheries do not meet the minimum sanitation and hygiene standards. This exposes meat to contamination by spoilage and pathogenic microorganisms. This study assessed sanitation and hygiene meat handling practices in SME butcheries in Nairobi and Isiolo counties, Kenya. A cross-sectional survey was conducted among 134 and 71 randomly selected butcheries in Nairobi and Isiolo counties, respectively. There was high participation of more educated youth (20-35 years) in butchery operation in Nairobi County compared to middle age (31-40 years) in Isiolo County. Seventy percent and 82% of operators in Nairobi and Isiolo Counties, respectively did not wear protective clothing. Ninety four percent and 88% of operators in Nairobi and Isiolo Counties, respectively did not have medical certificates. Eighty six percent and 69% of operators in Isiolo and Nairobi Counties, respectively had no training on meat handling hygiene. Sixty percent and 82% of operators in Nairobi and Isiolo counties, respectively did not wash their hands before handling meat. Ninety percent and 87% of operators in Isiolo and Nairobi Counties, respectively handled meat concurrently with handling money. Sixty percent and 34% of operators in Isiolo and Nairobi Counties, respectively cleaned utensils by wiping with reused cloth. Fifty eight percent and 27% of operators in Nairobi and Isiolo Counties, respectively used closed vehicles to transport meat from the slaughterhouse to the butcheries. The metallic containers or transport vehicles used were not refrigerated as the distances covered were below the minimum distance requiring refrigeration of meat during transportation. Eighty three percent and 47% of the operators in Nairobi and Isiolo Counties, respectively stored meat by hanging it in open space in butchery. The study showed that meat handling practices in SME butcheries in Kenya do not meet the required minimum sanitation and hygiene standards.

**Key words:** Sanitation and Hygiene Practices, Butchery Operators, Small and Medium Enterprise Butcheries, Kenya

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## Introduction

In Kenya, the livestock sector contributes about 47% to agricultural GDP (Irungu 2008; FAO 2005; Irungu et al. 2014) and 12% to overall national GDP (FAO 2005). The majority of livestock are concentrated in the arid and semi-arid lands (ASALs), which cover about 75% of the total Kenyan land surface. The livestock sector contributes about 90% of employment and more than 95% of family incomes in the ASALs.

Under Kenyan Vision 2030 and Millennium Development Goal 1 (MDG1) the Kenyan Government consider livestock production as an important economic activity that can be used to promote equity and reduce poverty particularly among the livestock keeping communities in ASALs and small and medium enterprises (SMEs) along the meat chain (Irungu et al. 2014). Meat production, especially beef, significantly contributes to household food and nutrition security and income of ASALs communities of Kenya (Irungu 2008). Beef production in Kenya is estimated at 390,000 metric tonnes with large amount of the supply

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coming from ASALs. Due to a growing population, urbanization and rising income there is a growing demand and consumption of meat and animal products in Kenya and other developing countries (Delgado et al. 1999; Irungu et al. 2014). Just like other developing countries, there exist strict regulations on standard and hygienic methods of handling and processing meats in Kenya (GOK 2012). However, the informal methods of meat handling and marketing meat by SMEs butcheries undermine meat quality and safety (Adzitey et al. 2011). This could be attributed to the less attention given to the implementation and enforcement of these regulations by butchery operators and public health authorities. However, supply of safe and quality meat is essential for protection of public health and access to regional and international market opportunities.

Meat is rich in nutrients and highly susceptible to microbial contamination that can cause foodborne illness to consumers and meat spoilage. This can result in quality deterioration hence quantity losses, economic losses and public health concerns (Komba et al. 2012). The types and extent of microbial contamination depend on sanitation procedures and hygienic practices during meat handling, storage, distribution and processing (Ercolini et al. 2006; Li et al. 2006; Adu-Gyamfi et al. 2012). Failure to observe good sanitation and hygiene practices such as washing of hands, wearing of protective clothing, cleaning and sanitization of butchery equipment and utensils, transportation of meat in clean containers and storage of meat at appropriately low temperatures can lead to microbial contamination, meat quality deterioration and post-harvest meat losses. Postharvest losses of fresh meat (up to 50%) handled by SME butcheries have been reported in Kenya (ANON 2012; Lewa 2010). A report by Abegaz (2008) for the Standards and Trade Development Facility, World Trade organization on Specific Sanitary and Phytosanitary market access constraints in East African Community countries states that the high perishability and post-harvest losses of meat are due to unhygienic meat handling practices and facilities. Therefore, the application of proper sanitation and hygiene techniques is important in maintaining meat safety and quality.

Fresh meat available in retail butchery outlets in Kenya passes through a long chain of slaughtering and transportation where each step poses a risk of microbial contamination (Irungu 2008). Although there exist meat hygiene and handling requirements for butcheries in Kenya, adherence to these requirements by most SME butcheries is low and not adequately documented. To facilitate improvements in sanitation and hygiene practices, determination of current compliant and noncompliant actions is necessary before designing and implementing any procedural changes. This study, therefore, aimed at assessing the current sanitation and hygiene meat handling practices in SME butcheries in Nairobi and Isiolo counties of Kenya. The findings of this study are useful in determining intervention strategies for improving hygienic

meat handling practices to prevent occurrence of foodborne illness and post-harvest meat losses in SME butcheries in Kenya.

## Material and Methods

**Study Sites:** The study was carried out in arid and semi-arid pastoral Isiolo County and majorly urban Nairobi County of Kenya between August 2014 and May 2015. Nairobi County has a total area of 696Km<sup>2</sup>. It is divided into 8 administrative Sub Counties, namely Makadara, Kamukunji, Starehe, Langata, Dagoretti, Westlands, Kasarani, and Embakasi Sub-Counties. According to 2009 population and housing census report, the Nairobi county has a population estimated at 3,138,295 (KNBS 2010); with half of the population living in slum areas. Lower, middle and upper middle income people are located in the North Central areas of the county while low and lower income estates are located in Eastern part of the county. SME butcheries are found in low and middle income parts of the County. The slaughterhouses clusters in Dagoretti, Kiserian and Njiru, on the outskirts of Nairobi County, provides meat to butcheries in the county. However there are a few emerging slaughterhouses in the eastern part of the county that also supply meat to butcheries in the county.

Isiolo County, located about 285 Km north of Nairobi, covers an area of 25,336Km<sup>2</sup> and has population of 143,294 people (KNBS 2010). It is divided into 3 administrative sub-counties, namely Isiolo Central, Merti and Garbatulla-Kinna Sub-Counties. Rainfall ranges between 150mm to 650mm per annum and the county experiences temperature ranging from 12<sup>o</sup>C to 28<sup>o</sup>C, typical of ASALs in Kenya. Livestock (cattle, sheep, goats and camels) keeping under pastoral system is main source of livelihood of the population in Isiolo county.

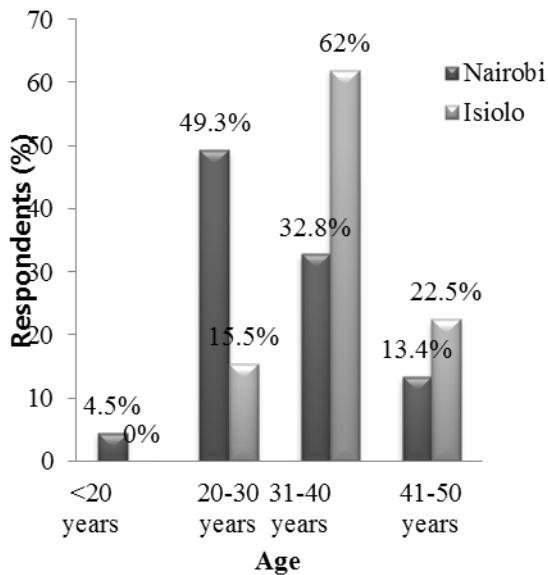
**Study Design and Data Collection:** The study units were SME butcheries while the study population were either butchery owners or butchery operators who were directly involved in the handling and selling of meat in the SME butcheries. One hundred and thirty four (134) and 71 SME butcheries were randomly selected in Nairobi and Isiolo County, respectively. A cross-sectional survey using semi-structured and pre-tested questionnaires was conducted to collect demographic information of the respondents and the sanitation and hygiene meat handling practices employed in the SME butcheries. The questionnaires were administered to butchery owner or one selected butchery operator in each SME butchery. The key elements of the questionnaire included: - gender, age and education of the butchery operators, possession of medical health certificate, attendance of training in meat handling hygiene, cleaning and sanitization of butchery equipment and utensils, status of meat transportation, distance from the slaughterhouse to the butchery, meat

storage and personnel hygiene. Critical observations of premises and personnel actions and key informant discussion were done during the administration of questionnaires. Permission to conduct the study was obtained from the country Ministry of Health, Public Health Office and the respondents gave written informed consent before responding to the questionnaire. The confidentiality of the respondents was maintained throughout the study.

**Statistical Analysis:** Data was analyzed using SPSS version 16. Frequencies and percentages were run to determine distributions.

### Results and Discussion

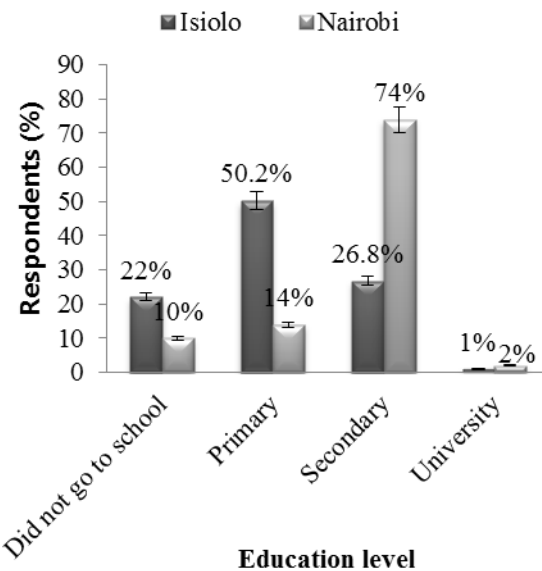
The age distribution of SME butchery operators in Nairobi and Isiolo counties is shown in Figure 1. In Isiolo County, 62% of the SME butchery operators were within age range of 31-40 years, while 49% of the butchery operators in Nairobi County were within age range of 20-30 years (Figure 1). This indicates that there is high participation of the youth (20-35 years) in SME butchery operations in more urban Nairobi County compared to middle age adults (31-40 years) in more rural Isiolo County. Several authors have reported that meat retailing business requires a lot of physical strength and need to be carried out by more energetic and active youth and middle aged men. Salifu and Teye (2006) reported that the butcher operations are quite energy demanding and may involve a lot of travelling to livestock markets hence the inability of older men to cope.



**Figure 1. Age distribution of the butchery operators in Nairobi and Isiolo Counties**

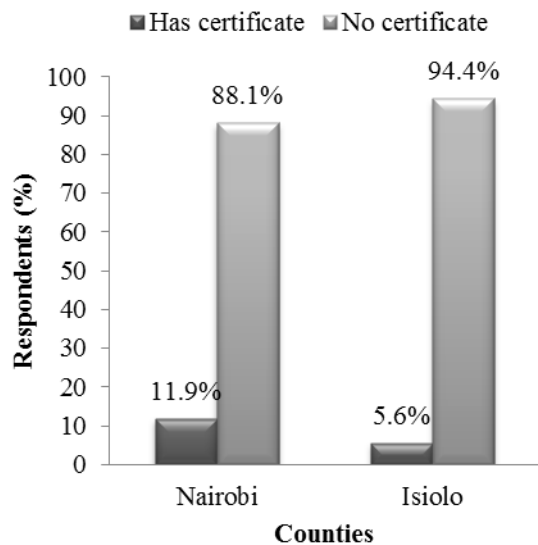
Adzitey et al. (2011) also reported that meat retailing activity in Bawku Municipality of the Upper Region, Ghana was dominated by youth and middle aged men within the ages of 41-50 (45%) followed by 31-40 (23%) and 21-30 (13%). Alhaji and Baiwa (2015) reported that majority (34.3%) of the workers in slaughterhouses in north-central Nigeria were in the age group 30–39 years. Ntang (2013) also reported that the age of workers in abattoir and retail meat outlets in Morogoro, Tanzania ranged between 18-40 years.

Figure 2 shows the education levels of the SME butchery operators in Nairobi and Isiolo counties. In Nairobi County, 74% of SME butchery operators had secondary school level of education and 10% had not gone to school. While 50% of the SME butchery operators in Isiolo County had primary school level of education and 2% had not gone to school (Figure 2). The butchery operators in more urban Nairobi County were more educated than the butchery operators in the more rural Isiolo County, however these differences in education level were not statistically significant ( $P>0.05$ ). This findings are in agreement by studies done by other researchers in developing countries. Ntanga (2013) and Ntanga et al. (2014) reported that 85% of the butchery operators in Morogoro Municipality, Tanzania had primary school education and 7.5% had not gone to school. The low level of education of SME butchery operators in Isiolo counties could make it difficult for them to comprehend and adhere to strict sanitation and hygienic meat handling practices necessary for prevention of microbial contamination of meat. Good conception of hygiene practices has been attributed to those employees with basic level (least a primary) of education, while bad practices to those who were illiterate (Afnabi et al. 2014).



**Figure 2: Education level of butchery operators in Isiolo and Nairobi Counties**

Figure 3 shows the results of SME butchery operators possessing medical health certificates in Nairobi and Isiolo counties. Ninety four (94) percent and 88% of the SME butchery operators in Isiolo and Nairobi Counties, respectively did not possess medical health certificates (Figure 3). Therefore there is a high possibility of the butchery operators contaminating meat with foodborne pathogenic microorganisms. This study confirms that although there exist personnel medical health requirements in Kenya (FAO 2005; GOK 2012) there is very little attention given to their implementation and enforcement in food enterprises like butcheries. Various studies, in other developing countries have shown different and varying possession of medical health certificate compliance rates.



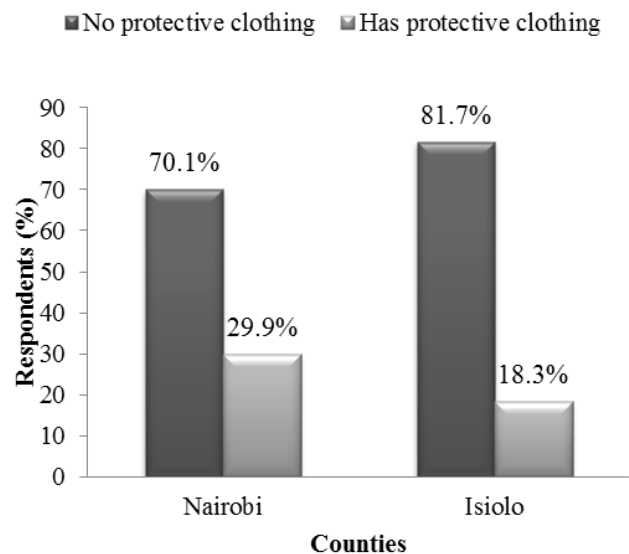
**Figure 3. The percentage of butchery operators with medical health certificates in Nairobi and Isiolo Counties**

Our study showed higher non-compliance rate than the study by Haileselassie et al. (2013) who reported that 15.4% of the butchery operators in Makelle city, Ethiopia did not have medical health certificates. Similar observation were made by Annan-Prah et al. (2011) who reported that 44.5% of street food handlers in Cape Coast, Ghana were not certified medically to handle food.

The percentage of SME butchery operators wearing protective clothing while handling and selling meat in Nairobi and Isiolo counties are shown in Figure 4. Seventy (70) percent and 82% of the SME butchery operators in Nairobi and Isiolo Counties, respectively did not wear protective clothing while selling meat (Figure 4). Ntanga (2013) and Ntanga et al. (2014) reported that 62.5% of the butchery workers in Morogoro municipality, Tanzania did not use protective clothing while selling meat. Haileselassie et al. (2013) also reported that 11.3% of butcher shop workers in Makelle city, Ethiopia did not use protective clothing while selling meat. Mirembe et al. (2015) reported

that only 31.5% of butchery workers in Kampala district, Uganda had personal protective wear.

As reported by other studies (Nel et al. 2004; WHO 2004; Muinde and Kuria 2005) the low usage of protective clothing in the SME butcheries in the study sites is indicative of increased risk of contamination of meat by butchery workers. Bryan et al. (1988) also reported that food handlers can be vectors for cross contamination of food whenever good personal hygiene or proper food handling practices are not practiced. Meat handler clothing can be possible sources of bacteria which can be transferred to meat during handling, resulting in foodborne diseases and meat spoilage hence post-harvest meat losses.

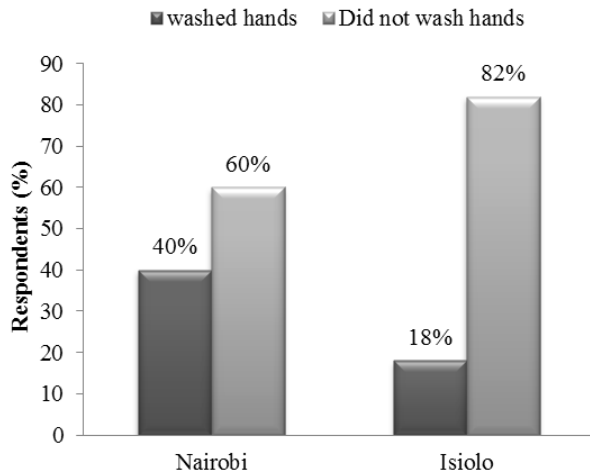


**Figure 4. The percentage of butchery operators wearing protective clothing in Nairobi and Isiolo Counties**

The percentage of SME butchery operators in Nairobi and Isiolo counties washing or not washing their hands before handling meat are shown in Figure 5. Sixty (60) percent and 82% of the SME butchery operators in Nairobi and Isiolo counties, respectively did not wash their hands before handling meat.

Ntanga et al. (2013); Ntanga et al. (2014) and Little et al. (1999) also reported that 37.5% and 29% of the butchery workers in Morogoro municipality, Tanzania and United Kingdom, respectively did not wash their hands before handling meat. Hand hygiene is not a new concept for prevention of microbial contamination of food in the food industry. Unfortunately, hand hygiene is neither not always carried out nor carried out effectively. Washing hand with a detergent has long been recognized as a major step toward avoiding microbial contamination and occurrence of foodborne pathogens in food production, preparation and service facilities. It has been established over decades that foodborne outbreaks occur in food operations because of lapses in hand hygiene. (Muinde and Kuria 2005; Greig et al. 2007). In an extensive review on hand washing Todd et al. (2010) stated that the reasons for food handling

personnel not washing their hands at appropriate times are laziness, time pressure, inadequate hand washing facilities and supplies, lack of accountability, and lack of involvement by industry management and workers in supporting proper hand washing.

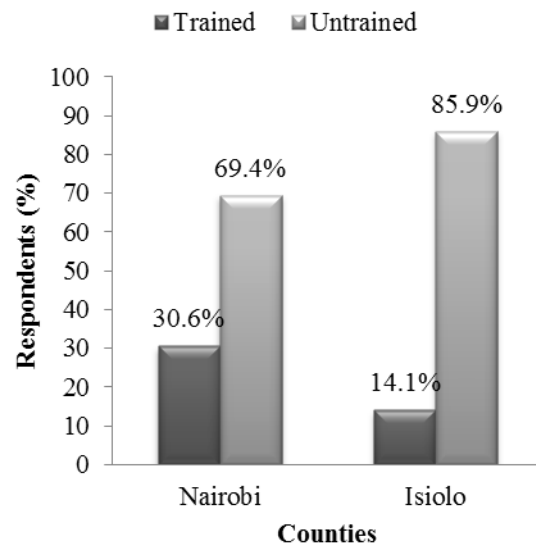


**Figure 5. The percentage of butchery operators washing hands before handling meat in Nairobi and Isiolo Counties**

However, strategies on how best to achieve complete and effective hand washing compliance has not been resolved even after many years of study and research (Todd et al. 2010). From our observation it was clear that the SME butchery operators were not practicing hand washing possibly due to lack of hand-washing facilities like unavailability of running tap water or water stored in container, washing basin, soap etc. It is recommended that training of butchery workers on personnel hygiene should therefore be conducted for the SME butchery operators and hand washing facilities availed to enable the butchery workers to frequently wash their hands.

The results of SME butchery operators trained in meat handling hygiene in Nairobi and Isiolo counties are shown in Figure 6. The percentage of SME butchery operators who had not undergone training in meat handling hygiene were 86% and 69% for Isiolo and Nairobi Counties, respectively (Figure 6). This results are comparable to those of other researchers who reported that 61.5% of the butchery operators in Makelle City, Ethiopia (Haileselassie et al. 2013) and 81% (Little et al. 1999) and 75% (Little and de Louvois 1998) of managers in butchers premises in the United Kingdom had received no food hygiene training. Similar findings have been reported in other food or meat handling establishment by other researchers. Alhaji and Baiwa (2015) also showed that 95.6% and 96.4% of the workers in slaughterhouses in north-central Nigeria did not have any previous training in meat handling hygiene and sanitation, respectively. However, Yakubu et al. (2015) reported that 97% of abattoir workers in metropolitan Kano State, Nigeria had received training on meat hygiene.

Gillespie et al. (2000) reported that managers in 88% of catering premises retailing ready-to-eat sliced meat in United Kingdom had received some form of food hygiene training and only 9% had received no food hygiene training. Significantly ( $P < 0.001$ ) fewer unsatisfactory samples were from premises where the managers had received advanced food hygiene training (14%) compared with those from premises where the managers had received intermediate (23%), basic (26%) or no (33%) food hygiene training (Gillespie et al. 2000).



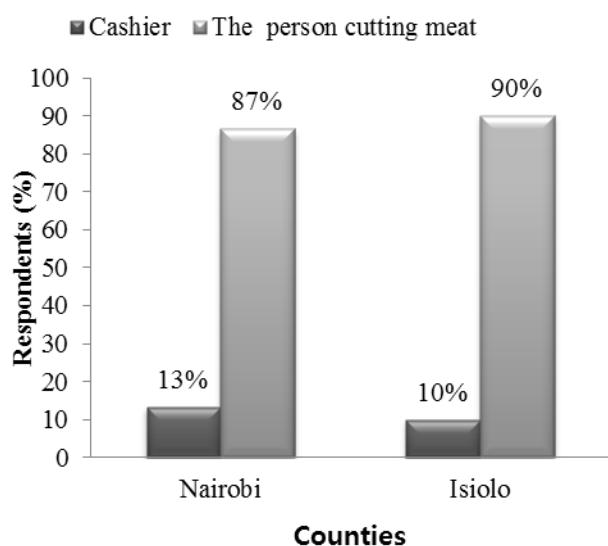
**Figure 6. The percentage of butchery operators trained on meat handling hygiene in Nairobi and Isiolo Counties**

Although most butchery operators in our study had not received formal training on meat handling hygiene, a few indicated that they had received informal interactive hygiene information sharing through worker to worker interaction. Our study indicates the need to organize training to sensitize the SME butchery workers on meat sanitation and hygiene in order to improve their knowledge of standard sanitary and hygienic operations for production of quality and safe meat (Alhaji and Baiwa, 2015). Training of food handlers regarding the basic concepts and requirements of personnel hygiene can play intergral part in assuring safe products to the consumer and reduction of meat post-harvest losses due to spoilage.

Personnel working in food establishment can be carriers of foodborne pathogens. Therefore, if improper personnel hygienic practices like not washing hands after visiting toilets or doing non-food related activities, lack of periodic medical health examination, careless sneezing and coughing (Nervy et al., 2011) are practiced, personnel can contaminate meat and pose public health concern. Literature suggests that food hygiene training as a means of improving food safety is limited by a lack of understanding of those factors contributing to successful outcomes. Training can not be effective unless its outcomes are

evaluated (Manpower Services Commission 1981). Critical factors for evaluating the effectiveness of any training programme include, among others, knowledge acquisition, changes in job-related personnel behaviour and performance, and improvements in organisational-level results. Therefore, training given in sanitation and hygiene should be able to change personnel behaviour and attitude as well as impart knowledge (Egan et al. 2007). However, training alone is not sufficient for long-lasting improvement in personnel hygiene. Several published articles indicate that more than training is needed to convince food industry workers to wash their hands to protect public health (Michaels and Ayers 2000; Michaels et al. 2002; Todd et al. 2010). Designed strategies must include modification of the organization culture to encourage good hygienic practices, motivation of employees, willing to use peer pressure on non-compliant coworkers and an operational design that facilitates regular hand hygiene.

Figure 7 shows percentage of SME butchery operators handling money and meat when retailing meat in Nairobi and Isiolo counties. Ninety (90) percent and 87% of the SME butchery operators in Isiolo and Nairobi County, respectively handled money concurrently with handling of meat (Figure 7).



**Figure 7. The percentage of butchery operators handling money in Nairobi and Isiolo counties**

The results of our study are higher than those reported by Haileselassie et al. (2013) in Makelle City, Ethiopia who found that 47.9% of the butchery operators handled money while handling meat. Muinde and Kuria, (2005) also reported that all the street food vendors in Nairobi, Kenya handled money while serving food. The person handling money should not be allowed to handle food during retailing or serving. This is because money is dirty and can contaminate food. The unhygienic conditions and habits of

handling money during circulation usually subject the money to contamination with a variety of microorganisms. The money can thereafter act as a vehicle for contaminating the hands of the food seller/handler and thus cross contaminating food (FAO, 1997; Muinde and Kuria 2005; Alemu 2014). Therefore, during retailing of meat in butcheries, money should not be handled concurrently with meat. According to Ferron et al. (2000) and Todd et al. (2010), the hands of food handlers who also proceed to carry out non-food related tasks e.g. handling money from customers, emptying bins, wiping counters with cloth are the most critical practices of transmitting foodborne pathogens from contaminated surfaces and items, hence resulting cross contamination of food.

Table 1 shows results of cleaning of the butchery utensils in SME butcheries in Nairobi and Isiolo counties. Thirty four (34) and 60% of the SME butcheries in Nairobi and Isiolo County, respectively cleaned butchery utensils like cutting knives, cutting boards, weighing scales and working surfaces by wiping with reusable piece of cloth. Cleaning of butchery utensils was well observed more in more urban Nairobi County than in more rural Isiolo County. Gillespie et al. (2000) reported that 53% of catering premises in United Kingdom used reusable dish cloths during cleaning. Twenty seven (27) percent and 30% of the butcheries in Nairobi County used cold water with soap or hot water with soap, respectively during cleaning, while only 4% and 7% of the butcheries in Isiolo County used cold water with soap or hot water with soap, respectively (Table 1).

The results of this study agrees with the work reported by Adzitey et al. (2011) in Bawku Municipality, Ghana. He reported that butchery workers did not clean butchery utensils appropriately and that 35% of the butchery operators wiped butchery utensils with a piece of cloth, 10% used hot water with soap, 39% used knives to scrap off chipped meat on tables and other surfaces while 16% used cold water and soap. Muinde and Kuria (2005) also reported that 70% of the street food vendors in Nairobi, Kenya cleaned their utensils in cold water.

Alhaji and Baiwa (2015) reported that cleaning of utensils and surface (17.4%) was the most common preventive hygiene practice and that only 16.3% knew about the protective capacity of frequent cleaning and sanitation of meat handling facilities.

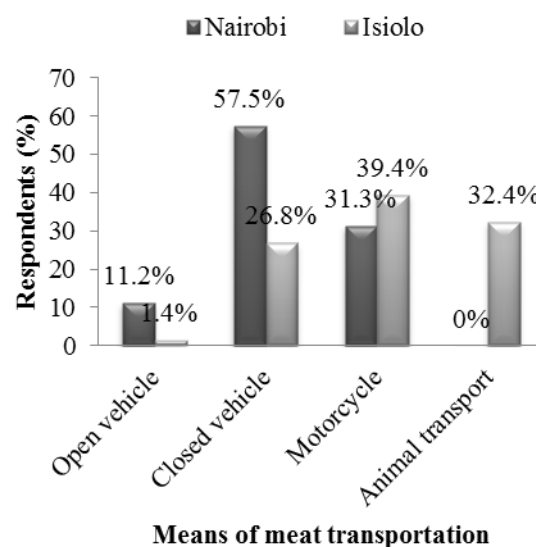
Our observation during the survey showed that after sale of organ meat, the butchery operators retailing meat also wiped cutting board and scales surfaces with dirty reusable cloth. We also observed that the piece of cloth used was not frequently washed or changed during the day. Although the intention was good, the wiping cloth was reused the whole day and can accumulate microorganisms that can be transferred to the butchery operators' hands, to utensil surfaces and finally to meat.

**Table 1. Methods of cleaning utensils by the butchery operators in Nairobi and Isiolo counties**

Ways of cleaning butchery Utensils	Responses	Responses
	Nairobi county (%) n=134	Isiolo County (%) n=71
Cold water only	4.5	10.5
Cold water and soap	26.6	4.2
Hot water only	6.0	25.4
Hot water and soap	30.1	7.0
Wiping with a piece of cloth	33.8	59.9

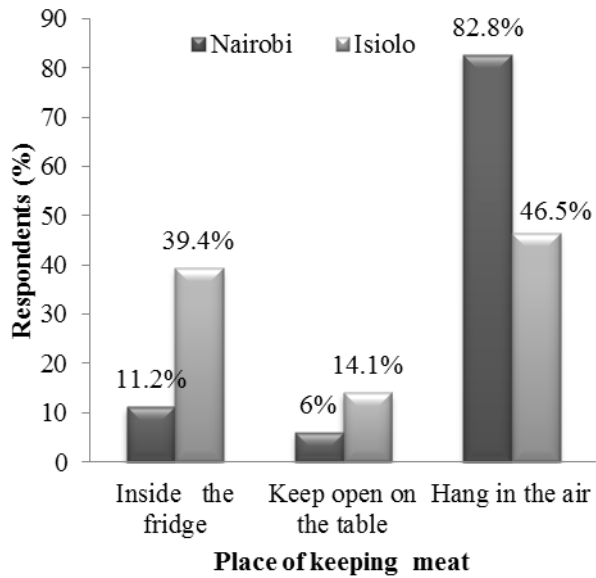
The study revealed that utensils in SME butcheries in the study sites were not cleaned adequately as 35.9% of operators did not use detergent during cleaning of utensils and surfaces. As observed during administering of the questionnaire, the majority of butcheries did not have running tap water and that water for cleaning utensils was kept in open plastic containers, was inadequate and reused, hence compromising on hygiene. These inadequate cleaning practices exposes meat to contamination by spoilage and pathogenic microorganisms, leading to meat post-harvest losses and public health concerns, respectively. Mirembe et al. (2015) reported that cleaning practices varied among butchers, with 75.3% of the butcheries in Kampala district, Uganda cleaning their butcheries daily and that 90.4% of most utensils were cleaned.

The results of means of transportation of meat from the slaughterhouse to the butchery by SME butchery operators in Nairobi and Isiolo counties are shown in Figure 8. Fifty eight (58) percent and 27% of the SME butchery operators in Nairobi and Isiolo County, respectively used closed vehicles to transport meat from the slaughterhouse to the butchery. However, motorbikes (39%) and animal (donkey) transport (32%) are the most preferred means of transporting meat from slaughterhouse to the butchery in Isiolo County (Figure 8). Similar observations on transportation of meat were made by Adzitey et al. (2011) in Bawku Municipality, Ghana who reported that 33% of butchery operators transported meat using motorbikes and bicycles, 30% used motorbikes, bicycles and push trucks while 19% used push track only. Despite the Meat Control (Transport of Meat) Regulations in Kenya stating that “NO other products except meat shall be transported in a carrier or container in which meat is transported” (GOK 2012), we observed that meat transport vehicles were also used to transport other food and non-food items. This could be a possible source of cross contamination and may compromise on safety and shelf-life of meat. It was also observed that some closed vehicle and containers used for meat transportation had blood stains from previous transported meat, indicative of inadequate cleaning.



**Figure 8. Means of meat transportation from slaughterhouse to the butchery in Nairobi and Isiolo counties**

Figure 9 shows how meat is stored by SME butchery operators in Nairobi and Isiolo counties. Despite being aware of the risk of meat getting spoiled when stored at room temperature, 83% and 47% of the SME butchery operators in Nairobi and Isiolo counties, respectively stored meat by hanging it in open space in designated room during retailing. A higher percentage (39.4%) of SME butchery operators in Isiolo County kept their meat in refrigerators than in Nairobi County (11%) (Figure 9). This could be attributed to high ambient temperatures (25- 30°C) in arid and semi-arid Isiolo County. Nonga et al. (2009) and Haruya (2012) reported that 85% of the butcher shops in Morogoro Municipality, Tanzania and 76.7% of butchers in Arusha, Tanzania, respectively did not have refrigerators.



**Figure 9. Meat storage by butchery operators in Nairobi and Isiolo Counties**

To overcome problem of lack of cold storage facilities the SME butchery operators usually stock only daily meat sale capacity. It was also observed that since most of the butcheries are located along dusty streets or roads, hanging meat in open space in the butchery exposes the meat to environmental contamination from dust and flies.

However, the serious concern of butchery operators in hanging meat in open space was weight reduction as results of moisture loss. Meat storage at refrigeration temperatures has been reported to reduce the growth of spoilage and pathogenic bacteria that may be present on meat surfaces (Koutsoumanis and Taoukis 2005), thus prolonging meat shelf-life.

Table 2 shows the distance covered during transportation of meat and the type of containers used by SME butchery operators when transporting meat from the slaughterhouse to the butcheries in Nairobi and Isiolo Counties. The SME butchery operators in both counties cleaned meat transport containers with cold water without any detergent. Majority of the SME butchery operators (95%) in Nairobi County transported meat from the slaughterhouse to the butchery using closed metallic containers which are cleaned with cold water (67%) and transported over a distance of 11-20Km (40%). Whereas, 92% of the SME butchery operators in Isiolo County transported meat from the slaughterhouse to the butchery using closed metallic containers cleaned with cold water (57%) and transported over a distance of 21-30km (58%) (Table 2).

It was observed that some of the closed metallic containers had indentations which could harbour microorganism which can result in meat contamination during transport.

**Table 2. The distance of meat transportation and the type of meat transport containers used by SME butchery operators for transportation of meat from the slaughterhouse to the butchery in Nairobi and Isiolo Counties**

Parameter	Nairobi County (%) N=71	Isiolo County (%) N=134
<b>Distance from slaughterhouse to butchery (Km)</b>		
<5	7.5	8
5-10	34.3	6
11-20	40.3	12
21-30	8.2	58
>30	9.7	16
<b>Type of Transport containers</b>		
Plastic crates	4	5
Closed metallic	95	92
Open metallic	1	3
<b>Cleaning the transport container</b>		
Cold water only	66.9	56.7
Cold water & soap	5.1	12.3
Hot water only	6.8	16.8
Hot water & soap	21.2	14.2



The metallic containers or transport vehicles were not refrigerated as the distances covered were below the minimum stipulated distance requiring refrigeration of meat during transportation (GOK 2012). Depending on the external environment temperature, temperature fluctuations may occur in meat if it is transported for long distance from the slaughterhouse to the butcheries, thus promoting growth of contaminating spoilage microorganism leading to meat spoilage and reduced shelf-life. The Kenyan Meat Control (Transport of Meat) Regulations state that if the distance of meat transportation is less than 50Km or two hours transportation duration, meat should be transported in non-insulated vehicles provided that they are fitted with sub-protection in the form of a double roof or protected from direct sunlight. However, if the transportation distance is more than 50km but less than 200km or four hours transportation duration, meat should be transported in insulated carriers and the insulation should allow only a maximum increase in the meat temperature of 1°C per hour. If the transport distance is more than 200Km or more than four hours transportation duration, meat should be transported in insulated carriers equipped with mechanical refrigeration or otherwise refrigerated sufficiently enough to ensure that the increase in the temperature of meat is less than 3°C during 12 hours daylight transportation (GOK 2012).

### Conclusion and Recommendation

The study revealed that majority of SME butchery operators in the Nairobi and Isiolo counties did not adhere to the required sanitation and hygiene standards. All the sanitation and hygiene handling practices investigated could provide avenues for contamination of meat and possibility of occurrence of foodborne pathogens and spoilage organism, hence raising public health concerns and meat spoilage. The study also showed that unhygienic problems in SME butcheries are not only limited to unhygienic meat handling practices but are also associated with unsanitary meat handling and selling practices i.e. handling money and wiping utensil surfaces with unclean and reused cloth. To ensure that every butchery operator follow the required rules for proper hygiene and sanitation, this study recommends that issuing of operating license should be pegged on butchery operators undergoing basic training on meat handling hygiene.

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### References

- Abegaz M. 2008. Mobilizing aid for trade for SPS-related technical cooperation in East Africa. Report of research work for the Standards and Trade Development Facility, 28-29 May 2008 Kampala, Uganda, 28-29 May 2008.
- Adu-Gyamfi A, Torgby-Tetteh W, Appiah V. 2012. Microbiological quality of chicken sold in Accra and determination of D<sub>10</sub>-Value of *E.coli*. Food Nutr. Sci. 3(5): 693-698.
- Adzitey F, Teye GA and Dinko MM. 2011. Pre and post-slaughter animal handling by butchers in the Bawku municipality of the Upper East Region of Ghana. Livestock. Res. for Rural Dev. Vol. 23, Article No 39. Retrieved August 22, 2015 from <http://www.lrrd.org/lrrd23/2/adzi23039.htm>.
- Afnabi RB, Nameni RP, Kamdem SS, Ngwa VN, Ngang JJE. 2014. Typology of the Cameroon traditional slaughterhouses based on hygiene practices. Adv. Animal and Vet. Sci. 2(8):477-478.
- Alemu A. 2014. Microbial contamination of currency notes and coins in circulation: A Potential public health hazard. Biomed. and Biotechnol, 2(3): 46-53.
- Alhaji NB and Baiwa M. 2015. Factors affecting workers' delivery of good hygienic and sanitary operations in slaughterhouses in north-central Nigeria. Sokoto J. Vet. Sci., 13 (1): 29-37.
- Annan-Prah AD, Amewowor AK, Osei-Kofi J, Amoono SE, Akorli SY, Saka E, Ndadi HA. 2011. Street foods: Handling, hygiene and client expectations in a World Heritage Site Town, Cape Coast, Ghana. Afric. J. Microbiol. Res. 5:1629-1634.
- ANON 2012. An overview of livestock sub-sector in Kenya: Perspectives, opportunities and innovations for market access for pastoral producers. Available at: <http://africa.procatur.org/wp-content/uploads/downloads/>. Accessed on August 22 2015.
- Bryan FL. 1988. Risks of practices, procedures and processes that lead to out-breaks of foodborne diseases. J. Food Prot. 51:663-673.

- Delgado CM, Rosegrant H, Steinfeld S, Ehu C, Courbois. 1999. Livestock to 2020: The next food revolution. Food, agriculture and the environment discussion paper 28, International Food Policy Research Institute (IFPRI) Washington DC.
- Egan MB, Raat MM, Grubb SM, Eves A, Lumbers ML, Dean MS. 2007. A review of food safety and food hygiene studies in the commercial sector. *Food Control*, 18:1180-1190.
- Ercolini D, Russo F, Torrieri E, Masi F, Villani F. 2006. Changes in the spoilage-related microbiota of beef during refrigerated storage under different packaging conditions. *Appl. Environ. Microbiol.* 72:4663-4671.
- FAO 1997. Guidelines for the design of control measures for street-vended foods in Africa. CAC/GL 22-1997. In: General Requirements (Food Hygiene). FAO Agriculture and Consumer Protection department, Codex Alimentarius Commission and Food and Agriculture Organization, Rome, Italy.
- FAO 2005. Livestock sector brief - Kenya. Page. 1. Food and Agriculture Organization, Rome Italy.
- Ferron S, Morgan J and O'Reilly M. 2000. Hygiene promotion: A practical manual for relief and development. Intermediate Technology: Warwickshire, England.
- Gillespie I, Little C and Mitchell R. 2000. Microbiological examination of cold ready-to-eat sliced meats from catering establishments in the United Kingdom. *J Appl. Microbiol.* 88:467-474.
- GOK. 2012. The Meat Control (Transport of Meat) Regulations, 1976, CAP 356. Pg. M11 – 37. Revised 2012. Government of Kenya. Government Printers, Nairobi, Kenya.
- Greig, JD, Todd ECD, Bartleson CA and Michaels BS. 2007. Outbreaks where food workers have been implicated in the spread of foodborne disease. Part 1: Description of the problem, methods, and agents involved. *J. Food Prot.* 70:1752–1761.
- Haileselassie M, Taddele H, Adhana K, Kalayou S. 2013. Food safety knowledge and practices of abattoir and butchery shops and the microbial profile of meat in Makelle City, Ethiopia. *Asian Pac. J. Trop. Biomed.* 3(5):407-412.
- Haruya T. 2012. An estimation of thermophilic *Campylobacter* population in ready-to-eat roast beef and chicken and the hygiene practices of sellers in beer bars in Arusha, Tanzania. Thesis, School of Veterinary Medicine, Rakuno Gakuen University.
- Irungu P, 2008. Contribution of the livestock sector to Kenya's GDP: A consultancy report to Agriculture Sector Coordinating Unit (ASCU), Ministry of Agriculture and Livestock Development, Nairobi, Kenya. page 26.
- Irungu P, Ithondoka P, Wafula E, Wekesa S, Wesonga H, Manga T. 2014. An audit of constraints and opportunities in Kenya's livestock export value chain. *J. Agric. Sci. and Technol.* B4:102-120E.
- KNBS 2010. The 2009 population and housing census report. Volume IC. Population distribution by age, sex and administrative units. Kenya National Bureau of Statistics. Available at: <http://www.knbs.or.ke>. Accessed August 14 2015.
- Komba EVG, Komba EV, Mkupasi EM, Mbyuzi AO, Mshamu S, Mzula A, Luwumbra D. 2012. Sanitary practices and occurrences of zoonotic conditions in cattle at slaughter in Morogoro municipality, Tanzania; Implication for public health. *Tanzania J. Health Res.* 14(2):1-12.
- Koutsoumanis KP, Taoukis P. 2005. Meat safety, refrigerated storage and transport: Modelling and management. In. J. N. Sofos (Ed). Improving the safety of fresh meat. pg. 503–56. Cambridge. UK. Woodhead/Publishing Ltd.
- Lewa AK. 2010. Evaluation of animal health care delivery systems in selected areas of Kenya. PhD thesis, University of Nairobi, Kenya
- Li MY, Zhou GH, Xu XL, Li CB, Zhu WY. 2006. Changes of bacterial diversity and main flora in chilled pork during storage using PCR-DGGE. *Food Microbiol.* 23(7):607-611.
- Little C, Gillespie I, de Louvois J, and Mitchell R. 1999. Microbiological investigation of halal butchery products and butchers' premises. *Commun. Dis. Public Health* 2:114-118.
- Little CL, de Louvois J. 1998. The microbiology examination of butchery products and butchers' premises in the United Kingdom. *J Appl. Microbiol.* 85:177-86.
- Manpower Services Commission (1981). Glossary of training terms (3rd ed.). London: HMSO.

- Michaels B and Ayers T 2000. Hazard analysis of the personal hygiene process, page 191–200. In. Proceedings of the 2nd National Sanitation Foundation International Conference on Food Safety, 11<sup>th</sup> to 13<sup>rd</sup> October 2000, Savannah, GA, USA
- Michaels B, Gangar V, Schultz A, Arenas M, Curiale M, Ayers T and Paulson D. 2002. Water temperature as a factor in hand washing efficacy. *Food Serv. Technol.* 2:139–149.
- Mirembe BB, Ndejjo R and Musoke D. 2015. Sanitation and hygiene status of butcheries in Kampala district, Uganda. *Afric. J. Food Agric. Nutri. Dev.* 15(3):1-8.
- Muinde OK, Kuria E. 2005. Hygienic and sanitary practices of vendors of street foods in Nairobi, Kenya. *Afric. J. Food Agric. Nutr. Dev.* 5(1):1-14.
- Nel S, Lues JFR, Buys EM, Venter P. 2004. The personal and general hygiene practices in the deboning room of a high through put red meat abattoir. *Food Control.* 15: 571-578.
- Nevry RK, Koussemon M, Coulibaly SO. 2011. Bacteriological quality of beef offered for retail sale in Cote d'ivoire. *Amer. J. Food Technol.* 6(9):835-842.
- Nonga HE, Sells P, Karimuribo ED. 2009. Occurrences of thermophilic *Campylobacter* in cattle slaughtered at Morogoro municipal abattoir, Tanzania. *J. Trop. Animal Health Prod.* 42:73-78.
- Ntanga PD, Mdegela RH, Nonga HE. 2014. Assessment of beef microbial contamination at abattoir and retail meat shops in Morogoro Municipality, Tanzania. *Tanzania Veter. J.* 29(2):53-61.
- Ntanga PS. 2013. Assessment of microbial contamination in beef from abattoir to retail meat outlets in Morogoro municipality. MSc. Dissertation, Sokoine University of Agriculture, Tanzania, pp20.
- Salifu S, Teye GA. 2006. The contribution of the various ruminant species to meat production in the Tamale Metropolis. The savanna farmer promoting local innovation in Northern Ghana. Vol. 7. No. 2. Page 35-37. The Association of Church Development Projects (ACDEP). Tamale, Ghana.
- Todd ED, Greig JD, Michaels BS, Bartleson C, Smith D, and Holah J. 2010. Outbreaks where food workers have been implicated in the spread of foodborne disease Part 11. Use of antiseptics and sanitizers in community settings and issues of hand hygiene. Compliance in health care and food industries. *J. Food Prot.* 73(12):2306-2320
- WHO 2004. Developing and maintaining food safety control systems for Africa. Current status and prospects for change. Page 12-14. Proceedings of second FAO/WHO Global Forum of Food Safety Regulators, Bangkok, Thailand.