MICROBIOLOGICAL CONTAMINATION IN CUTTING PROCESSES OF THAI INDIGENOUS BEEF

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Abstract—**The current study was conducted to evaluate the microbiological contamination in cutting processes of Thai indigenous beef, during July 2009 - March 2010. A total of sixty-one beef carcasses were selected from a standard slaughterhouse. Twenty-four-h chilled carcasses from the slaughterhouse, refrigerated truck, hands of loading staff, wall of chilling room, air blower of chilling room, 24-h chilled carcasses from cutting plant, cutting knives, cutting board, hands of cutting staff and beef were evaluated for quantity of total aerobic plate count, *Staphylococcus aureus* and *Escherichia coli*. The results indicated that the average quantity of total aerobic plate count, *S. aureus* and *E. coli* of all studied samples were lower than the TACFS standard in beef product. However, our results showed that few beef samples were microbiological contamination. In conclusion, the higher incidence of microbiological contamination in beef might be attributed to unhygienic and improper handling of animals during slaughtering, transporting and cutting processes.**

Key Words: Thai indiginous beef, microbiological contamination, beef, cutting processes.

I. INTRODUCTION

Beef is considered as an important source of proteins, essential amino acids, vitamins and minerals. According to this rich composition, it offers a highly favorable environment for the growth of both pathogenic and non-pathogenic bacteria. The microbiological contamination of carcasses occurs mainly during carcass processing and manipulation such as skinning, evisceration, storage and distribution at slaughterhouses and retail establishments (Abdalla, Siham, Suliman & Alian, 2009). Food processing and retails might be the key points of control for safety and quality assurance. Most microbiological contaminants of carcasses represent several kinds of bacteria such as *Salmonella* spp., *Escherichia coli* O157: H7, *Staphylococcus aureus, Campylobacter* spp. and *Listeria monocytogenes* resulting in a threat to consumer health (Scanga, Grona, Belk, Sofos, Bellinger & Smith, 2000; Samelis, Sofos, Kendall & Smith, 2001; Nouichi & Hamdi, 2009).

Food-borne illnesses in human beings are caused by eating food contaminated with pathogenic bacteria. A large number of pathogenic and spoilage microorganisms on meat can raise throughout meat processing. (Raftari, Jalilian, Abdulamir, Son, Sekawi & Fatimah. 2009). Counts of bacteria in meat are in the range 10^2-10^5 cfu/cm^2, but only around 10% of those are able to initiate growth (Nychas, Dillon & Board. 1988). Subsequently, when numbers of bacteria exceed 10^7 cells per cm^2, the first spoilage signs are detected, as off-odors. Another typical spoilage sign, bacterial slime, is noticeable with cell density around l0^8 cells per cm^2.

The earlier studies have demonstrated that the contaminations of carcasses were regularly recognized during the processing, especially in cutting processes. Hence, the aim of the present study is to evaluate microbiological contamination in Thai indigineous beef carcasses, equipments, beef and environments during processing.

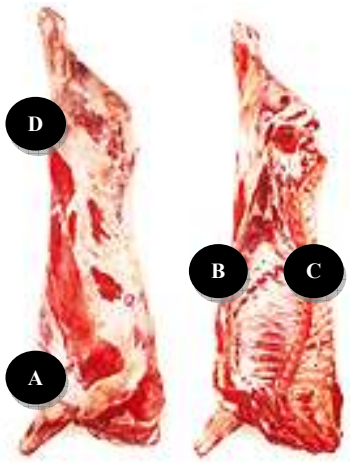
II. MATERIALS AND METHODS

Sample collection at a cutting plant was performed 8 times within 9 months (July 2009 - March 2010). A total of sixty-one Thai indigenous beef, belonging to different farms and coming from central areas of Thailand, were selected for slaughtering at a standard slaughterhouse in Nakhon Pathom. After chilling at 4°C for 24 hours at slaughterhouse, the carcasses were quickly transported by refrigerated truck to the meat processing plant in Bangkok. The carcasses were kept in chilling room for 24 hours before processing.

After storing at 4°C for 24 hours in chilling room at the cutting plant, all carcasses were taken samples from 4 separate sites (as shown in Fig. 1): axillary region of foreleg (A), interior of abdominal plate (B), interior of middle back (C) and axillary region of hideleg (D) by the swab technique; an area of 100 cm^2 was marked with a sterile frame for each site on each carcass. Refrigerated truck, hands of loading and cutting staff, equipments (cutting boards and knives), wall of chilling room and air blower of chilling room were sampled by the swab technique. Beef samples were collected from 4 primal cuts: chuck, rib, loin and round, totally sampled of 200 g. Swab samples were kept in sterile normal

saline water. All swab samples were further analyzed for total aerobic plate count (ISO 4833:2003), *Staphhylococcus aureus* (ISO 6888-1:1999) and *E. coli* (ISO 16649-2:2001). The results from the samples analysis were compared with the Thai Agricultural Commodity and Food Standard (TACFS)'s microbial standard of beef (6001-2004).

Figure 1. Locations of sampling sites on carcasses; axillary region of foreleg (A), interior of abdominal plate (B), interior of middle back (C) and axillary region of hideleg (D).



III. RESULTS AND DISCUSSION

The means of total aerobic plate count, *S. auerus* and *E. coli* are showed in Table 1. The level of total aerobic count in all studied samples was generally accepted as a criterion for microbial contamination of the TACFS standard (5×10^5 cfu/g) in beef product. However, the level of total aerobic count of 3 (4.92%) from 61 beef samples were higher than the TACFS standard. In this study, the beef carcasses from slaughterhouse were considered as the major parts of contamination in beef. Similarly result by James, Thornton, Ketteringham, & James (2000) revealed that the microbial contamination of meat starts during processing on the slaughter line. The microorganisms reach the carcass surface from where they penetrate into deeper layers of the meat. The unhygienic and improper handling of animal carcasses might be the main factors for producing meat with high microbial load. Nouichi & Hamdi (2009) reported the major sources of contamination are multiple contacts with contaminated tools and operators' hands. The greatest reductions in microbiological contamination on carcasses were achieved by adoption of dressing procedures that minimized hand contact with the carcass during pelt removal (Whyte, Holder, Tinker, Allen, White & Hinton. 2002). In this study, moreover, the findings suggest that the chilling room should be concerned in microbial contamination. Most microorganisms will not grow at freezing temperatures due to reduced metabolic activities; however, these microorganisms will begin to grow again when placed in warmer temperatures. Whereas Greer & Dilts (1987); found that blast chilling did not improve keeping quality of meat. Gill & Jones (1997) indicated that those are required to properly assess the microbiological effects of carcass cooling processes, because some factors other than temperature determine the proliferation of the microorganisms.

The level of *S. auerus* in all studied samples was generally accepted as a criterion for microbial contamination of the TACFS standard (1×10^2 cfu/g) in beef product. However, the level of *S. auerus* of 3 (4.92%) from 61 beef samples were higher than the level of the TACFS standard. In this case, Jeffery, Donald & Gill (2003) revealed that the worker hands and the equipment were the sources of *S. auerus* contamination in meat. Sanguankiat et al. (2008) showed that high levels of *S. aureus* might be contaminated from the worker hands in the cutting line. This microorganism can be found in water, dust and the air, but food handlers are the main source of food contamination. At least 30% of healthy people have *S. aureus* bacteria living in their nasal passages and on their hair and skin. Without good hygiene, these bacteria can easily end up in the foods. Given the right environment, *S. aureus* can multiply rapidly at room temperature, producing a toxin that is responsible for the condition known as staphylococcal food poisoning (Bremer, Fletcher & Osborne. 2004; USFDA. 2009)

The level of *E. coli* in all studied samples was lower than the recommended level of the TACFS standard (5×10^3 cfu/g) in beef product and subsequently would not be concerned with the contamination. Zhao et al. (2001) indicated that the *E. coli* was a part of the normal enteric flora that is presented in animals and often identified in food production, processing, and distribution environments. Fairbrother & Nadeau (2006) reported that the *E. coli* is one of the main inhabitants of the intestinal tract of most mammalian species, including humans and birds. Most *E. coli* are harmless, but small proportions are an important cause of disease worldwide. However, the findings in this study suggest that controlling of the contamination during transportation of carcasses from the slaughterhouse to the cutting plant should be considered as an effective strategy for food safety.

In general, there are also environment factors affecting microorganism contamination in meat. Hot and humid climate of Thailand, with ambient temperatures inducing the growth of microorganisms, can rapidly render meat unsafe for human consumption.

Table 1. Mean for aerobic plate count, *S. aureus* and *E. coli* counts of Thai indigenous beef carcasses, equipments, beef and environment during cutting processes.

Samples	Number of samples	Aerobic Plate Count	*S. aureus*	*E. coli*
		cfu	cfu	cfu
24-h chilled carcasses from slaughterhouse (cm^2)	61	3.35×10^4	16.93	5.01
refrigerated truck (cm^2)	6	1.75×10^4	< 10.00	16.00
hands of loading staff (hand)	4	1.64×10^3	< 10.00	< 1.00
wall of chilling room (cm^2)	8	1.93×10^3	< 10.00	< 1.00
air blower of chilling room (cm^2)	4	2.27×10^2	< 10.00	< 1.00
24-h chilled carcasses from cutting plant (cm^2)	61	9.58×10^3	10.62	1.72
cutting knives (knife)	8	2.98×10^3	< 10.00	< 1.00
cutting board (cm^2)	8	1.09×10^4	< 10.00	< 1.00
hands of cutting staff (hand)	4	1.89×10^2	< 10.00	< 1.00
beef (gram)	61	1.57×10^5	96.50	< 10.00

IV. CONCLUSION

In conclusion, the higher incidence of microbiological contamination in fresh Thai indigenous beef obtained in this study might be attributed to unhygienic and improper handling of animals during slaughtering, transporting and cutting processes. Thus, appropriate methods of beef carcass handling and sanitizing should be applied during slaughtering, transporting and cutting operations.

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