MICROBIAL CONTAMINATION IN SLAUGHTERING PROCESSES OF THAI INDIGENOUS CATTLE

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Abstract*—The present study was conducted to evaluate the microbial contamination in slaughtering processes of Thai indigenous cattle. Sixty-one of Thai indigenous cattle from central region of Thailand were slaughtered at a standard slaughterhouse. The carcasses from three steps of slaughtering processes (after evisceration, post-washing and after chilling), sticking wound, feces, equipment and environment in slaughterhouse were collected. The samples were evaluated for total aerobic plate count, *Escherichia coli* and *Staphylococcus aureus*. The results indicated that mean of total aerobic plate count on the carcasses from the three steps of the consecutively slaughtering processes (4.46×10^3 cfu/cm^2, 3.92×10^3 cfu/cm^2 and 3.35×10^4 cfu/cm^2, respectively) was below the TACFS standard in beef products. The high level of total aerobic count was found on transportation truck, feces and hands of staff (2.96×10^4 cfu/cm^2, 7.90×10^5 cfu/g and 2.48×10^4 cfu/hand, respectively). The mean of *E. coli* count on the carcasses from the three steps of the consecutively slaughter processes (8.21 cfu/cm^2, 2.20 cfu/cm^2, and 5.01 cfu/cm^2, respectively) were below the TACFS standard in beef products. The high level of *E. coli* count was found on transportation truck and feces (4.34×10^2 cfu/cm^2 and 9.84×10^4 cfu/g, respectively). Similarly, the mean of *S. aureus* count on the carcasses from the three steps of the consecutively slaughter processes (16.13 cfu/cm^2, 11.97 cfu/cm^2, and 16.93 cfu/cm^2, respectively) was below the TACFS standard in beef products. The high level of *S. aureus* count was found on feces and hands of staff (1.09×10^2 cfu/g and 1.53×10^2 cfu/hand, respectively). In conclusion, the level of microbial contamination on Thai indigenous cattle carcasses in slaughtering process, equipment and environment in slaughterhouse was generally accepted. This study finding suggested that the transportation truck, feces and hands of staff were considered as the main sources of microbial contamination.

***Key Words*—microbial contamination, slaughtering process, slaughterhouse, Thai indigenous cattle**

I. INTRODUCTION

Thai indigenous beef is considered as healthy food. It offers a highly protein and low fat/cholesterol. The other quality characteristics of Thai indigenous beef are firm texture, high water holding capacity and reddish color. Thai indigenous beef seem to be suit for Thai recipe and western meat product. However, for the safety of consumers, hygienic control in processing is necessary. The slaughtering process is a key important factor to assure meat safety. The microbial contamination of carcasses occurs mainly during slaughtering process such as bleeding, dressing, evisceration and storage (Sethakul, 1997). Animals are the source of contamination from microorganisms which are extremely presented in intestines, skin, feathers, hooves and droppings. Additionally, insufficiently cleaned equipment, worker hands and water are the important sources of microbial contamination. A level of aerobic plate count, *Escherichia coli* and *Staphylococcus aureus* are generally used as hygienic indicators in food chain (TACFS, 2004; Sanguankiat et al., 2008). The aerobic plate count depicts general microbial contamination, as indicator of health hazard and unhygienic process. *E. coli* is commonly found in the gut of humans and animals and is an indicator for possible fecal contamination. *S. aureus* is an important microorganism producing heat resistant toxin and is a significant indicator of food quality, surface cleanliness and personal hygiene (Engeljohn, 1999). Therefore, each process of slaughtering and unclean equipment and environment would be the important risks of microbial contamination in carcasses.

The aims of this study were to evaluate the microbial contamination level of Thai indigenous cattle carcasses in slaughtering processes, equipment and environment in slaughterhouse and to identify the main points of contamination in slaughtering processes and slaughterhouse facilities.

II. MATERIALS AND METHODS

A. Sample collection

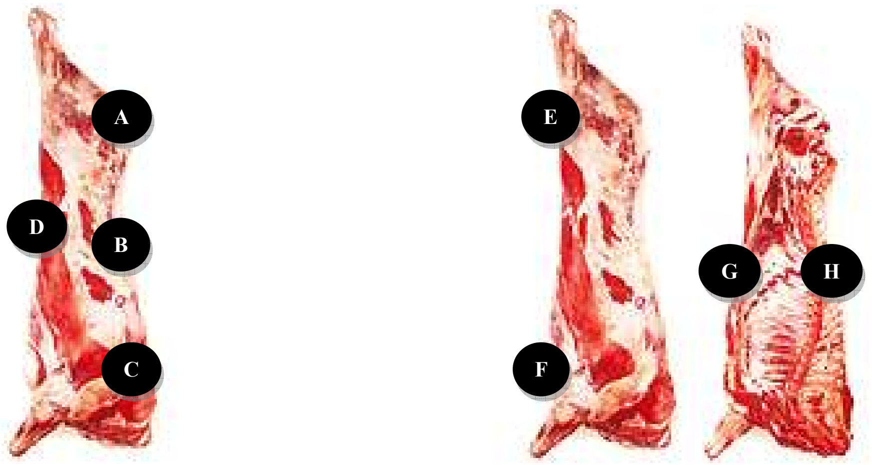
Sample collection was conducted 8 times at the standard slaughterhouse in Nakhon Pathom province. A total of 61 Thai indigenous cattle from the small farms in the central region of Thailand were transported to the slaughterhouse when the cattle have gained as slaughter weight. In slaughterhouse, cattle were received and the floor of transportation truck was sampled by the swab technique; the sampling area covered 100 cm^2. All cattle were kept in lairage for 12 hours and then driven to the slaughtering area where the following activities take place: stunning, bleeding, dressing, evisceration, splitting, washing, weighing and chilling.

After sticking and bleeding, the sticking wound was sampled by swabbing a surface of about 25 cm^2. Each carcass was sampled at the three steps of the slaughtering processes: after evisceration, post-washing and after chilling. For the carcass after evisceration, pre-washing, the sample was taken by swabbing from four 25 cm^2 areas at each of the rump (A), loin (B), shoulder (C) and ventral abdomen (D) as shown in Fig. 1 (totally 100 cm^2 sampled area). For the carcass at post-washing and after 24-hour chilling, the sample was taken by swabbing from four 25 cm^2 areas at each of axillary region of hide leg (E), axillary region of foreleg (F), interior abdominal plate (G) and interior surface of loin (H) as shown in Fig. 1 (totally 100 cm^2 sampled area).

About 100 g of feces were collected from large intestinal of each carcasses and placed in a sterile bag. One hundred milliliters of tap water were collected in a sterile bottle. Equipment (sticking knives and trimming knives) and hands of slaughterhouse staff were sampled before the start of the slaughtering by swabbing the entire material or hand. The wall of chilling room was also sampled by the swab technique; the sampling area covered 100 cm^2.

Swab samples were kept in sterile 0.85% NaCl solution. All samples kept in a refrigerated enclosure were quickly transported to the laboratory for further steps of analysis.

Figure 1. Locations of sampling sites on carcasses. 1-1: after evisceration; rump (A), loin (B), shoulder (C) and ventral abdomen (D). 1-2: post-washing and after chilling; axillary region of hide leg (E), axillary region of foreleg (F), interior abdominal plate (G) and interior surface of loin (H).



1-1: after evisceration 1-2: post-washing and after chilling

B. Microbiological analysis

All samples were analyzed for total aerobic plate count, *E. coli* and *S. aureus* in according to ISO 4833:2003, ISO 16649-2:2001 and ISO 6888-1:1999, respectively.

III. RESULTS AND DISCUSSION

The mean of total aerobic plate count, *E. coli* count and *S. auerus* count are showed in Table 1. The result have showed that the mean of total aerobic plate count on the floor of transportation truck was 2.96×10^4 cfu/cm^2. Cattle and their feces are possibly considered as the main sources of microbial contamination. Transportation truck must be efficiently cleaned both before and after transportation to reduce cross contamination to carcasses. Feces were found the high level of total aerobic plate count (7.90×10^5 cfu/g). Thus, careful operation during evisceration must be taken to prevent rupture of the intestines. The mean of total aerobic plate count on surface of sticking wound was 6.52×10^3 cfu/cm^2. At this point, dirty hides and sticking knives may be the sources of contamination. In this study, the sticking knives were found the rather high level of total aerobic plate count (5.01×10^3 cfu/knife). Insufficient cleaning and disinfection of the knives before the start of operation are possibly concerned. The mean of total aerobic plate count on the carcasses after evisceration (pre-washing), post-washing and after 24-hour chilling was 4.46×10^3 cfu/cm^2, 3.92×10^3 cfu/cm^2 and 3.35×10^4 cfu/cm^2, respectively. The results showed that the level of total aerobic count on the carcasses from the three steps of slaughtering processes was below the TACFS standard (5×10^5 cfu/g) in beef products (TACFS, 2004). In addition, the level of total aerobic count on the carcasses post-washing was less than on the carcasses after evisceration. This is in agreement with the study of Sheridan (2007) who reported that the processes of carcass decontamination using washing with water at different temperatures, steam pasteurization and hot lactic acid ability to remove bacteria from beef carcass surfaces. Consequently, washing operation and cleanness of water should be concerned. The mean of total aerobic plate count of tap water was 8.12×10^2 cfu/ml, which higher than the recommend level of drinking water (5×10^2 cfu/ml) by Ministry of Public Health of Thailand. The carcasses after 24-hour chilling were found higher level of total aerobic plate count, when compared with the carcasses after evisceration or post-washing. Gill & Jones (1997) indicated that some factors other than temperature determine the proliferation of the microorganisms in carcass cooling processes. Environment of chilling room may be a risk factor of carcasses contaminated. In this study, the wall of chilling room was found the rather high level of total aerobic plate count (8.88×10^3 cfu/cm^2). To prevent microbial contamination, the chilling room should be regularly cleaned. Nouichi & Hamdi (2009) reported that the major sources of contamination are multiple contacts with contaminated tools and operators' hands. The high level of mean total aerobic plate count was found at trimming knives and hands of staff in this study (4.91×10^3 cfu/knife and 2.48×10^4 cfu/hand, respectively). These were directly contacted with the carcasses at each step of slaughtering processes. Effective cleaning and great care of personal hygiene would reduce contamination on the cattle carcasses. However, the level of total aerobic count in all studied samples was generally accepted as a criterion for microbial contamination of the TACFS standard in beef product (TACFS, 2004).

The high level of *E. coli* count was found at the floor of transportation truck and feces (4.34×10^2 cfu/cm^2 and 9.84×10^4 cfu/g, respectively). Usually, *E. coli* is found in the gut of animals. WHO (1995) reported that feces are main sources of *Escherichia coli* O157:H7, as pathogenic microorganism. It is essential to prevent the transfer of *E. coli* from the cattle and feces to the carcass surface. Therefore, transportation truck must be efficiently cleaned both before and after transportation. Particular care must be taken during the removal of the stomach or intestine. However, the current study detected the very low level of *E. coli* count on the carcasses after evisceration (pre-washing), post-washing and after 24-hour chilling (8.21 cfu/cm^2, 2.20 cfu/cm^2, and 5.01 cfu/cm^2, respectively). The results showed that the level of *E. coli* count on the carcasses from the three steps of slaughtering process was below the TACFS standard (5×10^3 cfu/g) in beef products (TACFS, 2004). The other samples were similarly found the very low level of *E. coli* count, as shown in Table 1.

The result from this study showed that feces were detected the high level of *S. aureus* count (1.09×10^2 cfu/g). Hence, the careful operation during evisceration must be taken to ensure non-rupture of the intestines. The level of *S. aureus* count on the carcasses after evisceration (pre-washing), post-washing and after 24-hour chilling was 16.13 cfu/cm^2, 11.97 cfu/cm^2, and 16.93 cfu/cm^2, respectively. The results showed that the level of *S. aureus* count on the carcasses from the three steps of slaughtering process was below the TACFS standard (1×10^2 cfu/g) in beef products (TACFS, 2004). Interestingly, the high level of *S. aureus* contamination was found on the hands of staff (1.53×10^2 cfu/hand). This is in accordance to the establishment of Sanguankiat et al. (2008) who showed that high levels of *S. aureus* contamination were found on the worker hands in the cutting line. Thus, the personal hygiene procedure should be concerned to protect microbial contamination on the cattle carcasses. However, the other samples were found the low level of *S. aureus* count, as shown in Table 1.

Table 1. Mean of total aerobic plate count, *E. coli* count and *S. aureus* count of Thai indigenous cattle carcasses, equipment and environment in slaughtering processes.

Samples	Number of samples	Aerobic Plate Count		*E. coli*	*S. aureus*
		cfu	log cfu	cfu	cfu
Floor of transportation truck (cm^2)	8	2.96×10^4	4.40	4.34×10^2	< 10.00
Feces (gram)	61	7.90×10^5	5.44	9.84×10^4	1.09×10^2
Sticking wound (cm^2)	30	6.52×10^3	3.46	17.50	11.80
Carcasses after evisceration (cm^2)	61	4.46×10^3	3.24	8.21	16.13
Carcasses post-washing (cm^2)	61	3.92×10^3	3.00	2.20	11.97
Carcasses after 24-hour chilling (cm^2)	61	3.35×10^4	4.18	5.01	16.93
Sticking knives (knife)	8	5.01×10^3	3.61	< 1.00	< 10.00
Trimming knives (knife)	8	4.91×10^3	2.47	< 1.00	< 10.00
Wall of chilling room (cm^2)	8	8.88×10^3	3.59	< 1.00	< 10.00
Hands of staff (hand)	3	2.48×10^4	4.29	4.33	1.53×10^2
Tap water (milliliter)	8	8.12×10^2	2.82	< 1.00	< 10.00

IV. CONCLUSION

From this study, the results showed that the level of microbial contamination on Thai indigenous cattle carcasses in slaughtering process, equipment and environments in slaughterhouse was generally accepted. The main points of contamination in slaughtering processes were the transportation truck, feces and hands of staff. Thus, insufficient cleaning and disinfection of the transportation truck, careful operation during evisceration and the personal hygiene procedure should be concerned to protect microbial contamination on the carcasses.

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