1. INTRODUCTION AND OBJECTIVES

Meat is an important element in most people's diets and its safety depends upon the application of effective control measures at all stages of the production chain, literally from 'farm to fork'. In order to assure meat quality and safety, there has to be co-operation from all parties involved in the food production chain. These are farmers, feed manufacturers, livestock market operators, livestock haulers, abattoir operators and those working in food processing plants. Regulatory authorities that conduct meat inspection and those who work in food-borne disease surveillance and disease control play an important role in the national surveillance system.

There are three categories of food safety hazards: chemical, physical and microbiological hazards. The last one causes the highest incidence of food-borne illness (WHO, 2005). Microbiological contamination can originate from living animals or plants or from cross-contamination at pre-harvest and post-harvest levels. Many microorganisms are ubiquitous in nature; consequently pathogenic microorganisms can enter the food chain in many stages. Therefore, the entire supply chain has to be involved in controlling microbiological risks (Berends *et al.*, 1998). Microorganisms thrive best in high protein, non-acid environments such as meat, which makes meat a serious risk for food-borne illness. In general, the bacteria *Salmonella* and *Campylobacter* cause most food-borne illness (CDC, 2003).

Good hygienic practices (GMP) can prevent and control zoonoses and food-borne diseases as well as pollution of the environment. Food hygiene also contributes significantly to the improvement of food quality as well as to reduction in food losses, the elimination of adulteration and fraud; the prevention of dumping contaminated or substandard food. Proper hygiene practices promote development of the food industry and improvement of food making systems.

Sanitation and cleaning are an integral part of slaughtering and the handling of meat and should already be taken into consideration at the planning and construction stage of slaughter facilities. Well-planned, well-executed controlled cleaning and

sanitation programs for rooms, machines and equipment are important elements in achieving hygienic standard. Cleaning and sanitation alone, however, will not assure a hygienic standard in production. Processing hygiene as well as personal hygiene is also important factors.

Many human enteric diseases are associated with the consumption of food of animal origin, caused by organisms present in the guts of healthy animals (WHO, 2005). These organisms are not detected by routine meat inspection. Organisms, initially present in low numbers, proliferate when the food product is incorrectly handled during processing, distribution or preparation. Prevention of food-borne illness therefore depends on control measures at all points in the food chain, from live animals through processing to consumption. Emphasizing control only at the kitchen level will therefore never succeed. This also reflects the major role of veterinary food hygienists in protecting consumer safety.

Regulatory authorities have often been forced to apply the classical rules of food inspection, because there is insufficient information to support changes to a more science-based program. To be more reliable, regulatory authorities have an inevitable task in designing and operating modern food inspection programs, which are well-defined and proven to be scientifically based.

The classical zoonoses, such as tuberculosis, were eradicated through efficient inspection of slaughter animals and meat inspection. As earlier mentioned, at and after slaughter *Salmonella, Campylobacter,* enterohaemorrhagic *Escherichia coli* and *Yersinia* can be released from clinically healthy animals, thus contaminating carcasses and meat. *Salmonellae, E. coli* and *Listeria* can also survive in the abattoir environment (Rostagno *et al.*, 2003; Borch *et al.*,1996).

In order to overcome the problems of food-borne diseases, the production line must be kept in good hygienic fashion. Sampling for bacteriological analysis to detect the contamination rate in different stages of the food chain is the best way to monitor and to keep the hygienic status of slaughterhouses and food processing plants. Also

visual inspection of the hygienic condition of live animals, the surface of working materials, workers' clothes, meat inspectors and meat inspection tools, as well as consideration of additional aspects that can bring cross contamination are needed.

In HACCP systems, the indicator organisms that suggest quality in process control, validation and verification are the total aerobic count, coliforms, *Escherichia*, *Aeromonas* and *Listeria*; the latter two are more pathogenic and hygienic indicators. The total aerobic count is an indicator for the general microbiological condition of the product and equipment (Gill, 2000). *Enterobacteriaceae* counts are accepted as an indicator for fecal contamination (McEvoy *et al.*, 2004; Nel *et al.*, 2004; Zweifel *et al.*, 2005; Byrne *et al.*, 2005).

In Lao PDR, The Department of Livestock and Fisheries (DLF) is responsible for animal heath and production including safety aspects of animal products for human consumption. DLF has developed a national plan for the improvement of the quality of products of animal origin to meet international standards. Local veterinary authorities supervise the slaughterhouses and slaughter facilities. Permanent staffs work under a qualified manager. The meat inspector is independent of the manager who is responsible to the local or governmental veterinary or livestock authorities.

Until now there has been, however, no report on hygienic studies of slaughterhouses in Lao PDR. The DLF as the organization responsible for the quality and safety of animal products needs science-based knowledge in order to come up with proper solutions. The findings of this study will serve as initial data for The Department of Livestock and Fisheries and for carrying out further research and development.

The objective of the study

The purpose of this study was to determine the microbiological contamination of pig carcasses in order to evaluate the microbiological quality of pig carcasses and assess the hygienic status of the selected slaughterhouse. Isolation of most important

microorganisms will indicate the microbiological quality and safety of such products. For this purpose, according to the working document “The development of a risk based on a meat inspection system, EN SANCO/4403/2000”, it is recommended that the routine analysis should be based on Total Viable Count and *Enterobacteriaceae.* In this study the indicator bacteria would be Total Viable Count (Aerobic Plate Counts), *Enterobacteriaceae* counts, and more specifically the *Salmonella* isolation and identification of the samples. The specific objectives of this study are:

- To determine and compare the contamination level of Total Bacteria Counts and *Enterobacteriaceae* counts in pig carcasses between pre- and post-evisceration;
- To estimate the prevalence of *Salmonella* isolated from pig carcasses and lymph nodes, and to assess the association between the prevalence and groups of pigs with regard to herd size, transport time, source of water and source of pigs, together with information on farm management practices.
- To discuss the critical steps in the slaughtering procedure in order to formulate necessary actions for improvement.