CHAPTER I

INTRODUCTION AND OBJECTIVES

1.1 Introduction

Antimicrobial resistance (AMR) is the resistance of a microorganism to an antimicrobial medicine to which it was originally sensitive (WHO, 2013). Antimicrobials have revolutionized the treatment of infectious diseases (WHO, 2011). From the earlier part of 1950s, antimicrobials have been used in agriculture, including livestock and poultry, with the purpose of treating infections and improving growth and feed efficiency (Hutchinson et al., 1991). Till today antimicrobials are used for the purpose to control and prevent infection (Tollefson and Miller, 2000) due to welfare and economic reasons of production (Bywater et al., 2004), although for improving growth purpose is forbidden in European Union (Gallois et al., 2009). However, the development and spread of antimicrobial resistance caused by the use and misuse of them now become to a significant health problem. According to the estimation by WHO, over 25,000 people die from infections caused by antimicrobial resistant bacteria each year in the European Union alone. Furthermore, for the purpose of disease treatment, prevention or growth promotion, antimicrobials used in food animals allows resistant bacteria and resistance genes to spread from food animals to humans through the food-chain (WHO, 2011). Moreover, resistant bacteria from the intestinal flora of food animals can contaminate carcasses of slaughtered animals and thus transfer resistance genes to the microflora of humans via the food chain (Skovgaard, 2007).

Extended-spectrum β-lactamases (ESBLs) are enzymes produced by Gram-negative bacteria that inactivate oxyimino cephalosporins, conferring resistance to them. Bacteria producing ESBLs are resistant to cephalosporins such as cefuroxime,

cefotaxime, ceftazidime and ceftriaxone, and, through genetically linked resistance mechanisms, they are often resistant to other antibacterials including quinolones and aminoglycosides. Most ESBL-producing organisms are thus multidrug resistant and many are only susceptible to carbapenems, along with little-used agents such as fosfomycin (Hunter et al., 2010).

Antimicrobial resistance in bacteria has emerged as a problem in both human and veterinary medicine. Some studies demonstrated that the level of antimicrobial resistance of the enterobacteria is considered a good indicator for selection pressure exerted by antimicrobial agents use and development of resistance in pathogens, because enterobacteria of human and animal origins constitute an enormous reservoir of resistance genes for commensal and pathogenic bacteria. (Lester et al., 1990, Murray, 1992, van den Bogaard and Stobberingh, 2000). Farms including dairy farms are a reservoir of ESBL-producing *E. coli* (Geser et al., 2012). The occurrence of ESBL-producing *Enterobacteriaceae* in the fecal microflora of farm animals represents an obvious risk for the contamination of raw food products from animal origin (Geser et al., 2012). Therefore, ESBL-producing *E. coli* may be transmitted to human beings through raw milk or contact to the animals' direct environment such as dairy mattresses or even by the surroundings of dairy farms. Preventing, controlling and reduction ESBL-producing *E. coli* in dairy farms is very important for the health of humans and animals, and thus, their welfare.

A broad consensus reached that antimicrobial resistance has become a serious public health problem in China, with high resistance rates of most common bacteria to clinically important antimicrobial agents. This problem has attracted the attention of some universities and Chinese government so that a comprehensive antimicrobial resistance surveillance system in tertiary hospitals has been established. In China, antimicrobial resistance surveillance began in the 1980s; the first antimicrobial resistance surveillance network was established by Fudan University in 1998 and Peking University has conducted national antimicrobial resistance surveillance since 1999; in 2004, the Ministry of Health (MOH) established MOH National Antibacterial Resistance Investigation Net (Mohnarin) (Xiao et al., 2011). ESBL

SHV-2 was first reported in the 1990s and CTX-M was the predominant ESBL family among *Enterobacteriaceae* in China. Data collected from tertiary hospitals showed a varying prevalence of ESBL-producing *E. coli* across different regions of China, with the lowest incidence in Urumuchi (28.5%), the highest in Wuhan (78%), and in Beijing was 52.1% in 2008 (Xiao et al., 2011).

In veterinary medicine section in China, there are only little data on the ESBL-producing *E. coli* in farm animals and there are no published studies describing the herd prevalence of ESBL-producing *E. coli* and the risk factors associated in dairy farms in Beijing area. A previous study carried out in pig farms in Sichuan Province, China, between August 2002 and February 2007 demonstrated the prevalence of ESBL-producing *E. coli* increased dramatically from 2.2% to 10.7% during this period, and this increase appeared mostly related to the dissemination of CTX-M-type ESBLs among *E. coli* isolates (Tian et al., 2009).

China has significantly promoted the dairy industry, enlarged its dairy cow numbers and increased its dairy processing capacity over the last decades in attempt to answer the increased demand for dairy products. China's net imports of dairy products, however, have expanded at a growth rate in excess of 30% during year 2003 to 2008. Total dairy cow number has increased by 40%, from 8.93 million in 2003 to 12.33 million in 2008 (CDSY, 2003-2009). Concerning Beijing, dairy farming is the most important in agriculture sector.

For aforementioned concerns, we carried out this study to investigate the prevalence of ESBL-producing *E. coli* in dairy farms in Beijing area within a cross sectional study, and analyzed the risk factors associated with the detection of ESBL-producing *E. coli*. Microbiological and biochemical methods were carried out in this study to survey the herd prevalence of ESBL-producing *E. coli* in dairy farm in Beijing China. In the meantime, questionnaires were used to investigate the information including farm administration, sanitation and antimicrobial using history. The studies investigated the herd prevalence of ESBL-producing *E. coli* in dairy farms, the association between producing ESBLs and dairy cow disease and the risk

factors of the ESBL distribution, so that some prevention measures were suggested. It belongs to the category of applied research. The studies are useful for the prevention of ESBL-producing *E. coli* transfer and some dairy disease associated with ESBL-producing *E. coli*. It is also useful to prevent the potential ESBL-producing *E. coli* transfer to humans, protecting human health.

1.2 Objectives of the study

- To investigate the herd prevalence of ESBL-producing *E. coli* in dairy farms in Beijing within a cross sectional.
- To analyze risk factors associated with the detection of ESBL-producing *E. coli* in dairy farms in Beijing.
- To propose suggestions for the prevention and control of ESBL-producing *E. coli* transmission and spread.