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Original Article

Analysis of veterinary drug residue monitoring results for commercial livestock products in Taiwan between 2011 and 2015

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ABSTRACT

Antibiotics have been widely used in the treatment of livestock diseases. However, the emergence of issues related to drug resistance prompted governments to enact a series of laws regulating the use of antibiotics in livestock. Following control of the problem of drug resistant bacteria, public attention has shifted to the recurring incidence of human health and safety issues caused by residual veterinary drugs in livestock products. To guarantee the safety and hygiene of meat, milk, and eggs from food-producing animals, governments and relevant agencies established laws and regulations for the use of veterinary drugs. It is, therefore, necessary to monitor the content of residual drugs in livestock products at regular intervals to assess whether the regulations have resulted in the effective management of food product safety, and to prevent and manage sudden problems related to this issue. A 2011–2015 livestock product post-marketing monitoring program launched by the Taiwan Food and Drug Administration (TFDA) inspected 1487 livestock products. Over the past 5 years, there were 34 samples identified that did not conform to the regulations; these samples included residue drugs such as β -agonists, chloramphenicols, β -lactam antibiotics, sulfa drugs, enrofloxacin, and lincomycin. Inspections of commercial livestock products with the consistent cooperation of agricultural authorities did not detect the drugs that were banned by the government, whereas the detection of other drugs decreased annually with an increase in the post-market monitoring sample size. In the future, the TFDA will continue to monitor the status of residual veterinary drugs in commercial livestock products, adjust the sampling of food products annually according to monitoring results, and closely cooperate with agricultural authorities on source management.

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1. Introduction

With a gradual increase in the global demand for proteins, which has necessitated vigorous development of the livestock industry, antibiotics are being increasingly used for the treatment of livestock diseases. Furthermore, because animal feed containing antibiotics results in improved growth and feed conversion rates in food-producing animals, feeding model wherein small amounts of antibiotics are added to animal feed was instituted in the livestock industry. Unfortunately, the presence of drug-resistant bacteria in food-producing animals has emerged [1]. Evidences had shown that there was a survey to estimate the prevalence and antimicrobial resistance of *Salmonella* from pigs at slaughter in Taiwan. The rates of resistance to the following drugs were observed: tetracycline (88.2%), gentamycin (82.7%), chloramphenicol (54.3%), amoxicillin (34.6%), nalidixic acid (30.7%), ampicillin (26.8%), kanamycin (18.1%), cephalothin (7.1%), nitrofurantoin (6.3%), ciprofloxacin (0.8%). Among 127 *Salmonella* strains, 119 strains (93.7%) were resistant to 2 or more antibiotics [2]. Some studies have reported that animal feed containing antibiotics results in the emergence of antibiotic resistance, which severely affects medical treatment methods in human and veterinary medicine, and can lead to situations in which drugs are completely ineffective [3]. This problem has encouraged national governments to increase their focus on the use of antibiotics in animal feed within the livestock industry and to implement regulations restricting these types of animal feed [4].

Successful outcomes of these regulatory actions have been reported [5,6]. For example, in Taiwan, the Veterinary Drugs Control Act was enacted to improve the quality of veterinary drugs, enhance animal health, and foster a robust livestock industry. To prevent or reduce the development of drug-resistant bacteria in animals, the Bureau of Animal and Plant Health Inspection and Quarantine (BAPHIQ), Council of Agriculture, Executive Yuan, has monitored domestic pig and chicken farms since 1990, testing for drug resistance in pathogens that affect humans, such as *Salmonella*, *Campylobacter*, *Escherichia coli*, and *Enterococcus*, within livestock manure. The results of this monitoring have been used as a basis for halting the use of certain antibiotics. For example, after discontinuing the use of avoparcin in chicken farms, the resistance of enterococci in chickens towards vancomycin significantly decreased to the point of no resistance [7]. The competent authority BAPHIQ, the Council of Agriculture continuously announces relevant information on its website [8].

With the gradual increase in control over the problem of drug resistance, other situations in which residual antibiotics in products from food-producing animals may affect human health have emerged. For example, in Spain, in 1990, more than 100 people who consumed the liver that was contaminated with clenbuterol, experienced increased heart rates, muscular tremors, headaches, nausea, fever, chills, and other symptoms, and required emergency medical treatment [9]. Furthermore, there have been reports of rash outbreaks in individuals who drank milk containing residual penicillin [10].

To ensure the safety and hygiene of meat, milk, and egg products, regulatory laws have been established for veterinary

drugs used in food-producing animals, which allow regular monitoring for residual veterinary drugs in livestock products. This can help assess the efficacy of government policies in managing food safety, prevention, and control of sudden food safety incidents [11,12]. Taiwan considers the safety and hygiene of commercial agricultural, livestock, and aquatic products as a serious public health management responsibility [13–21], and uses these monitoring results as a reference to assess risks to food product safety and as a primary source for information on risk management policies and risk communication strategies [22]. Therefore, the Taiwan Food and Drug Administration (TFDA) together with regional health bureaus implemented a post-market monitoring program for livestock products between 2011 and 2015. This program was used to monitor and develop an understanding of whether levels of residual veterinary drugs in commercial livestock products complied with the veterinary drug residue standards in Taiwan.

2. Methods

2.1. Sample sources

Samples were taken by the TFDA and regional health bureaus that assessed the seasonality and regional specialty of products, and then acquired samples including those of pork, pig organs, mutton, beef, processed meats, cow milk, and sheep milk, from retail markets, traditional markets, supermarkets, restaurants, and wholesale markets. The strategy is considered according to the intensive feeding status in Taiwan food producing animal farm where are mostly located in the mid-southern Taiwan. And the seasonal changes might be a factor for leading animal sickness, what follows the medication. The quantity of such samples has increased annually.

2.2. Testing methods

Tests were conducted according to the directions of the TFDA. The analyzed items and the analytical instruments used are described in Table 1. All antibiotics listed in Table 1 are the commonly used in Taiwan.

3. Results and discussion

3.1. Commercial livestock product veterinary drug residue monitoring results

The sampling of commercial livestock products between 2011 and 2015 accumulated 1487 samples; monitoring requirements were more comprehensive in 2015. In addition to the routine sampling of commercial livestock products, we sampled high-risk items including those with high failure rates between 2011 and 2014, and items that the public commonly consumed or consumed in large volumes (such as pork, chicken, and milk). The analyses showed that non-compliance rates exhibited a gradually decreasing annual trend (Fig. 1). Only a small portion of samples contained veterinary drug residue levels not conforming to regulations

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