

Improvement on Education of Animal Pharmacy Profession to Adapt the Transformation of Animal Pharmaceutical Industry in China

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ABSTRACT

Aim(s): To introduce the structural adjustment of the animal pharmaceutical industry in China and our improvement on animal pharmacy profession education. **Study Design:** Investigated the change of this industry, and reported our improvement on the education of this profession. **Methods:** The development on intensive animal production, non-pollution foods, and marketing mode of animal drugs of animal pharmaceutical industry, and the standardized management system, merger, product development capability of the animal pharmaceutical industry was investigated, and the theoretical teaching and practical teaching of the animal pharmacy profession in the Southwest University of China (SWU) were improved. **Results:** Development of animal husbandry leads to transformation of animal pharmaceutical industry, and education of animal pharmacy profession should focus on development trend of this industry. Our improvement on the animal pharmacy profession education was focus on the theoretical teaching and practical teaching to improve the innovation abilities of the animal pharmacy profession students. **Conclusion:** The transformation of animal pharmaceutical industry in China demanded universities to change the direction and methods of the animal pharmacy profession education to meet the needs of the employment market and society better, and the theoretical teaching and practical teaching of the animal pharmacy profession in SWU was a good attempt to face the transformation in animal pharmaceutical industry.

Key words: Animal Pharmacy Profession, Education, Animal Pharmaceutical Industry, Structural Adjustment, Personnel Training, Innovation.

INTRODUCTION

As an undergraduate profession of universities, animal pharmacy profession has been established for more than 10 years in China.¹ To meet the flourish of the animal pharmaceutical industry, in 2003, this profession is approved to be established in Nanjing Agricultural University by the Ministry of Education of China. Nowadays, 16 universities are approved to open the undergraduate animal pharmacy profession (Table 1). The aim of this profession is to train students to have abilities on producing, ameliorating, marketing, using, and researching of animal used drugs. However, limited by its short history and less experience accumulation, education of this profession is still in

exploring, especially facing the structural adjustment of the animal pharmaceutical industry today.^{2,3} Therefore, it is worthy to discuss the direction and methods of the animal pharmacy profession education to meet the needs of the employment market and society better.

MATERIALS AND METHODS

The current situation of the animal pharmacy profession education in China

The beginning year, educational years, students per year of the animal pharmacy profession of 16 universities which are

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Table 1: Universities opened the undergraduate animal pharmacy profession in China			
Universities	Profession beginning	Educational years	Students /year
Nanjing Agricultural University	2004	5	30
South China Agricultural University	2005	4-5	30
Hunan Agricultural University	2005	4	30-45
Jiangxi Agricultural University	2008	4	40
Jilin University	2008	4	30
Northeast Agricultural University	2008	4	30
Inner Mongolia Agricultural University	2012	4	90
Xinjiang Agricultural University	2012	4	30
Heilongjiang Bayi Agricultural University	2013	4	30
Yangtze University	2013	4	30
Hebei Agricultural University	2013	4	30
Henan University of Science	2013	4	30
Tianjin Agricultural College	2013	4	30
Qingdao Agricultural University,	2015	4	30
Southwest University	2015	4	30-60
Southwest University of Nationalities	2016	4	30

approved to open the undergraduate animal pharmacy profession were investigated to understand the current situation of the animal pharmacy profession education.

The transformation of animal pharmaceutical industry in China

The development on intensive animal production, non-pollution foods, and marketing mode of animal drugs of animal pharmaceutical industry, and the standardized management system, merger, product development capability of the animal pharmaceutical industry was investigated to understand the transformation of animal pharmaceutical industry.

The improvement on animal pharmacy profession education in SWU

The theoretical teaching and practical teaching of the animal pharmacy profession in the Southwest University of China (SWU) were improved to meet this transformation in the animal pharmaceutical industry.

RESULTS AND DISCUSSION

Development of animal husbandry leads to transformation of animal pharmaceutical industry

Intensive animal production inevitably leads to structural adjustment of kinds of animal drugs

At present, intensive animal production administrated by modern breeding enterprises has been the mainly culture mode of China, which provides more than 60% of animal-origin foods in the market. The epidemic

prevention conditions in these enterprises is much better than that of traditional scatter breeding workshops, which leads to the changes on the market of animal used drugs. Attributed to the lower incidence of infectious diseases and serious resistance issue in the modern breeding enterprises, application amount of anti-infectives is decreased, and antiviral agents are inhibited to use on animals by Chinese law, but the market share of biologicals and Chinese animal medicine are obviously increased in the last 8 years (Table 2). Food safety problems induced by animal drug residues also contribute to the change of animal drug application in clinic. Nowadays, development of anti-infectives is facing a bottleneck problem and becoming very difficult, however, products of biologicals, immunopotentiator, probiotics and Chinese animal medicine will be the leading products of animal pharmaceutical industry in the future. Market share of drugs used on swine and poultry will be decreased, and that of drugs used on companion animals and aquatic animals, especially drugs on companion animals will be increased significantly.

Society demands on non-pollution foods promote development of animal drugs

Recently, many animal-origin food safety incidents as residue of animal drugs and feed additives occur in China. One reason for these issues is that the technique and management of many farms are still lagging in China. There are large amount of shortages as poorer farming environment, higher disease incidence, serious environmental pollution, weaker animal health and so on in many farms. Therefore, overload of antibiotics

Table 2: Market share of different kinds of animal drugs in 2007 and 2015

Drug type	Market shares (%)	
	2007	2015
Anti-infectives	35	13.6
Parasitic agent	27	27
Medical food additives	5	11.3
biologicals	18	27
Chinese animal medicine	15	21.1

Table 3: Investigation on drug development departments of animal pharmacy companies in China

Enterprise type	Have				No	
	Established		Establishing		Numbers	%
	Numbers	%	Numbers	%		
Biologicals enterprise	3	6.38	3	6.38	41	87.2
Chemical drug enterprise	142	16.53	141	16.41	576	67.06
Biological and Chemical enterprise	4	100	0	0	0	0
Total	149	16.37	144	15.82	617	67.81

are used in some farms to maintain the health of animals, which leads to the increasing cost of farming and declining quality of animal products, as well as brings food safety issues as drug residues.⁴ Gradually get rid of malignant competitions on less innovate antibiotics according to the National Drug Standards of China with low competitiveness, and develop safe, efficient and environment friendly innovate alternatives of antibiotics are becoming new research and development direction of animal used drugs in China. Some new products as enzymes, probiotics, and antimicrobial peptides have been used in farms now, but the clinical application of them are limited by their higher requirements to research and produce, and the market share of them is still relatively low. Therefore, the arrival of “antibiotic-free” era in Chinese animal husbandry is still a long way to go.

Marketing mode of animal drugs in intensive animal production is experiencing fundamental changes

As the development of intensive animal production, markets of animal drugs are centralizing simultaneously. More and more companies sale their drugs to these big farms directly, and their sale philosophy is gradually changing from products sales to combination of product sales and technical services sales. Therefore, professional knowledge of animal medicine is crucial for salesmen of animal pharmacy companies, and excellent technology service to intensive farms is becoming the critical step for companies to expand profit margins, maintain stable customers, and compete for terminal market.⁵ Otherwise, as the development of the sales philosophy, depth marketing and marketing alliance

are becoming the innovate marketing mode of some of these animal pharmacy companies.⁶ These changes on marketing mode of animal pharmacy companies demand employees not only to have rich marketing skills on animal drugs but also better specialized knowledge on animal medicine and animal drug, which are essential to treat complex clinical cases. These changes will obviously influence the education of animal pharmacy profession students.

Education of animal pharmacy profession should focus on development trend of animal pharmaceutical industry

Standardized management system on animal pharmaceutical industry intensify the market competition

Management system on animal pharmaceutical industry is becoming more and more perfect in China. Good Manufacturing Practice (GMP) on animal pharmaceutical companies started from 1989, and the “Implementation Rules on Management Standard of Quality of Veterinary Drug Production” are promulgated by the Agriculture Ministry of China in 1994, which demanded that all animal pharmacy companies must pass the GMP authentication. Legal system and supervision system on registration review, quality inspection, production and business operation licensing, and administrative punishment have been established and perfected today. As the increasingly regulated animal pharmaceutical industry operations, substandard drugs gradually withdraw from the market, and disorderly vicious competitions are controlled. As a result, competitions in animal drug market are undoubtedly more transparent

and more intensified, which is conducive to the healthy development of this industry.

Merger in animal pharmaceutical industry is imperative

As the data from network database of GMP animal pharmacy enterprise in China, until September of 2015, the total number of GMP animal pharmacy companies is 2010, only about 90 of them produce veterinary biological product, whereas almost 99.9% of them produce homogeneous chemicals, and most of them are small-scale companies with an output value less than 10 million RMB per year.⁷ In 2012, the number of companies with annual production value of more than 1 billion RMB is just 23, and the total annual production value of top 20 companies is about 53.39% of all companies.⁸ All this data indicate that there are too many small-scale animal pharmacy companies in China now. These small-scale companies just provide low level products with lower market competition, so they are weak in resisting risk and are more likely to be eliminated. Nowadays, many small-scale companies are struggling in the depression of animal drug market in China. Therefore, merger of animal pharmaceutical industry is imperative, which can concentrate superior resources of these small companies to expand their business scale, improve their competitiveness, and enhance their risk resistance capacity. In this inevitable trend, graduates of animal pharmacy profession will experience greater pressure and variable on their employment.

Product development capability is becoming the core competitiveness of animal pharmacy companies

As market competition intensifying, the ability to provide innovate productions is crucial for animal pharmacy companies. Therefore, more and more companies are increasing their investment on product development to improve the quality and competitiveness of their products. Animal drug market is gradually entering a brand era in China.⁹ According to an investigation on more than 900 animal pharmacy companies (Table 3), about 32.94% of all chemotherapy drug companies in China have established or are establishing their own research and development department, but the scale of most of these departments is small. About half of these departments just have less than 5 researchers, whereas about 8.61% of these departments have more than 20 researchers. All researchers serviced in animal pharmacy companies in China are just about 10 thousand now.¹⁰ Another issue on the development of Chinese animal drug is the low investment of most of the companies on it. In 2012, the mean investment of animal pharmacy

companies on drug development in China is just about 5.82% of their annual sales, and the total investment of these companies is just 70% of that of the Pfizer. These data indicate that investment on animal drug development in China is far from enough, and the reason is associated with not only the shortage of these companies' size and strength, but also the shortage of animal drug researchers in China, which should be solved by improvement on the education of animal pharmacy professionals.

Our development on the education of animal pharmacy profession

To adapt the transformation of animal pharmaceutical industry in China, we improve the follow aspects on education of animal pharmacy profession in the Southwest University of China.

Theoretical teaching is more responsive to the transformation of animal pharmaceutical industry

Course system is improved to focus on both animal pharmacy and animal medicine

There are two kinds of animal pharmacy profession course systems in China. The first one gives priority to pharmacy discipline, and the second one gives consideration to both animal pharmacy course and animal medicine course, which is adopted by our university. In the first course system, the main courses are pharmacy related courses as Medicinal Chemistry, Physical Chemistry, Animal Pharmacology, Animal Pharmaceutical Analysis, Pharmacy, and Formulaology. The main courses of the second course system consider both pharmacy related courses as Medicinal Chemistry, Animal Pharmacology, Animal Pharmaceutical Analysis, and animal medicine courses as Animal Anatomy, Animal Embryology, Animal Biochemistry, Animal Physiology, Animal Pathology, and Animal Microbiology.¹¹ Facing with the development trends of animal pharmaceutical industry in china, graduates with only monotonous pharmacy knowledge are relatively less competitiveness and difficult to meet the market demand, whereas, graduates of our university with professional knowledge on both animal pharmacy course and animal medicine course have better opportunities in employment market.

Knowledge system of animal pharmacy profession is improved to be more diversification

In Southwest University, the focus content of certain course is adjusted to the demand of the animal husbandry. For example, the focus content of Animal Pharmacology is changed from chemotherapeutic drug related knowledge to knowledge on biological products,

immunopotentiators, probiotics, and natural Chinese medicine and so on. Otherwise, we gradually increase the knowledge of drugs used on companion animals, aquatic animals, cattle, and sheep, especially drugs of companion animals, which attach less importance in the previous knowledge system.

Practical teaching of animal pharmacy profession is particular emphasis on improving student's innovation ability

At present, researchers of animal pharmaceutical industry is far from adequate in China, therefore, employment direction of animal pharmacy graduates are changing. In the past, the most popular position in animal pharmacy companies for animal pharmacy graduates is salesman. However, researchers with higher abilities are the priority selection of the companies today. How to train innovative researchers for these companies? Adjustment on teaching objectives, majorization on teaching system structure, improvement on teaching environment, implementation of flexible teaching operation, seminar-style classroom teaching, autonomous experimental training and training of innovative teachers are all indispensable.¹² In addition, we focus on the following four aspects:

Training dual-ability teachers

Dual-ability teachers should have abilities not only on teaching and research, but also on drug development, producing, marketing, and clinical application. They should perfectly combine the education, scientific research, and drug production. Many university teachers of animal pharmacy profession in China usually pay more attention to theory and basic research than practice and development of drugs, which obviously limit the training quality of animal pharmacy students, and lead to their lack of practice abilities in animal pharmacy companies. Therefore, dual-ability teachers are crucial for improving practice abilities of animal pharmacy professional. Our university sends more than 5 teachers a year to take part in the production process of some cooperative animal pharmacy companies for 3 months to enhance their practice abilities, after evaluation, these teachers are named dual-ability teachers and become framework teachers of the animal pharmacy profession, and the quality of their pharmaceutical related courses is greatly improved.

Systematically training of innovation abilities

Through organization of innovative experiments, animal pharmacy skills competitions, and other measures, many universities in China are emphasis on cultivating students' innovation ability now, but this is far from enough. Innovation ability must rely on innovative

thought, emotion, and personality and so on. Training of innovation is not just a purely intellectual process. It requires driving forces as innovative emotion and personality, lofty ideals, strong faith, sincere enthusiasm, and strong enthusiasm and so on.¹³ Through "Boxue Training Class", we select some students with strong interest in drug development, and systematically train their innovation abilities not only on drug development but also on innovative thought, emotion, and personality. After graduation, their abilities on animal drug development are approved by their companies.

Provide more opportunities on independent and innovative research projects

Many research projects on animal drug development as the Students Challenge Cup and the Innovation Fund are invested by the university and Chinese government to train innovation abilities of our animal pharmacy profession students. To finish these projects, they should design, prepare, implement, and complete their research as well as their research report themselves, and their tutors just give them some key guidance. Through these research projects, the innovation abilities of these students are greatly enhanced.

Effectively promote the school-enterprise cooperation

The animal pharmacy profession of Southwest University has more than 260 practice bases all over the country, and most of them are animal pharmacy companies. Every year, we send more than 50 students to take part in the drug development departments of these companies for 3 months to rich their practice experience, and more than 3 professors from these companies are invited to teach some courses as Company Management and Drug Marketing in the university. Otherwise, some course as Pharmaceutical Equipment Science are managed to carry out in the workshop of these companies. Discussions between students and employees are organized frequently, which is very helpful for students of animal pharmacy profession to deeply understand their theoretical knowledge and their future work.¹⁴

CONCLUSION

The transformation of animal pharmaceutical industry in China demanded universities to change the direction and methods of the animal pharmacy profession education to meet the needs of the employment market and society better, and the theoretical teaching and practical teaching of the animal pharmacy profession in SWU was a good attempt to face the transformation in animal pharmaceutical industry.

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CONFLICT OF INTEREST

The authors contributing to this study and manuscript have no conflict of interests.

ABBREVIATIONS USED

SWU: the Southwest University of China; **GMP:** Good Manufacturing Practice; **RMB:** Renminbi.

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PICTORIAL ABSTRACT



SUMMARY

- 16 universities are approved to open the undergraduate animal pharmacy profession in China till now.
- Development of animal husbandry leads to transformation of animal pharmaceutical industry, and education of animal pharmacy profession should focus on development trend of this industry.
- Theoretical teaching and practical teaching of the animal pharmacy profession in SWU is a good attempt to face the transformation in animal pharmaceutical industry.

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