

Research on the Teaching System for the Professional Master of Pharmacy

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Abstract—There is a need to cultivate high-level, high-quality pharmaceutical professionals competent in innovative drug research and development, drug quality evaluation, drug circulation supervision, and other pharmacy-related areas. These areas should be incorporated into the three Master of Pharmaceutical Research dimensions: marine pharmaceuticals and biological products, pharmaceutical analysis and quality control, and pharmaceutical synthesis and preparation. A well-designed curriculum enables students to master scientific knowledge of modern pharmacy and become familiar with the new trends and recent progress in the field. This article introduces a teaching system according to the requirements of the professional training program and the specific situation of each student. The development of a training plan that focuses on pertinence and practicality and considers the actual problems in pharmacy and related fields will cultivate the students' innovative consciousness and ability, hence improving their technical skills and competitiveness in employment. The curriculum should therefore foster advanced application-oriented pharmacy graduates.

Keywords—Professional master of pharmacy; Curriculum; Teaching system; The research features

I. INTRODUCTION

The continuous improvement of the pharmaceutical industry and the increasing scarcity of top talents in the field justify China's current demand for the training of application-oriented pharmaceutical master's students by high-quality and competent professionals.[1] Since 2009, China has increased the enrollment of full-time master's degree students in the pharmacy specialty in order to change the traditional education development strategy of training academic talents and cultivating practical talents to meet the needs of the market.[2]

The establishment of a curriculum teaching system represents a crucial link for talent cultivation.[3,4] According to the requirements of the professional master's degree, such as a master's degree in professional skills, a graduate can independently conduct drug synthesis and preparation, marine drug and biological product research, drug analysis, and quality control work. There is, however, a need for further development and room for improvement. There are three research dimensions of the Master of Pharmacy degree in the university: marine pharmaceuticals and biological products, pharmaceutical analysis and quality control, and pharmaceutical synthesis and preparation. The university also

offers degree courses and elective vocational training courses, which include public courses, general theoretical knowledge, professional knowledge in the field, and no less than one year of professional practice. On the one hand, the courses enable students to comprehensively master the basic theoretical knowledge of pharmacy and modern science and technology, become familiar with the new trends and progress in the field of pharmacy, and comprehensively improve the quality of their self-study skills. On the other hand, according to the requirements of the professional training program and the specific situation of each student, the development of a training plan that focuses on pertinence and practicality and considers the actual problems in pharmacy and related fields will cultivate the students' innovative consciousness and ability, hence improving their technical skills and competitiveness in employment.

II. EXPLORING A CURRICULUM TEACHING SYSTEM SUITABLE FOR A FULL-TIME PROFESSIONAL MASTER'S DEGREE MAJORING IN PHARMACY

Personalized education is currently the mainstream and the most efficient method for full-time postgraduate education. Its significance lies in the difficulties of the required knowledge and content structures, due to different research and employment directions. Therefore, the course content should be developed under the guidance of each student's training plan and research dimension.[5] The curriculum system includes degree courses, elective courses, and professional practice (Fig. 1). Degree courses include public courses, general theory courses, and specialized knowledge courses. Public courses focus on developing an ardent love of students' motherland and a spirit that abides by national laws and regulations so as to cultivate good political and ideological qualities and professional ethics. General theory courses include pharmaceutical progress, domestic and foreign pharmaceutical laws and regulations, experimental design and data analysis, and pharmaceutical chromatography. Specialized knowledge courses in this field comprise modern pharmaceutical chemistry, modern pharmaceuticals, modern pharmaceutical analysis, modern marine pharmaceuticals and biological products, modern pharmacology and cell biology. The system adopts various forms of teaching, such as case teaching, induction teaching, special reports and group discussions to guide students to study independently and improve their understanding of the course. The courses, including

experimental design and data analysis, pharmaceutical chromatography, modern pharmaceutical chemistry, modern pharmacy, modern pharmaceutical analysis, modern marine pharmaceuticals and biological products, modern pharmacology and cell biology, enable students to understand quality control and experimental design; to learn experimental data processing methods master the basic and necessary theoretical knowledge, systematic professional knowledge, and modern practical skills necessary for the pharmaceutical specialty; and to gain an understanding of the development of marine drugs. New achievements and new methods in the field of pharmacy are reflected in the courses on pharmaceutical progress and domestic and foreign pharmaceutical laws and regulations. This helps students to understand cutting-edge knowledge and the latest research progress in the field of pharmacy. It also assists them in tapping into the potential of their practice, competence, and high-level talents for future innovative research and work.

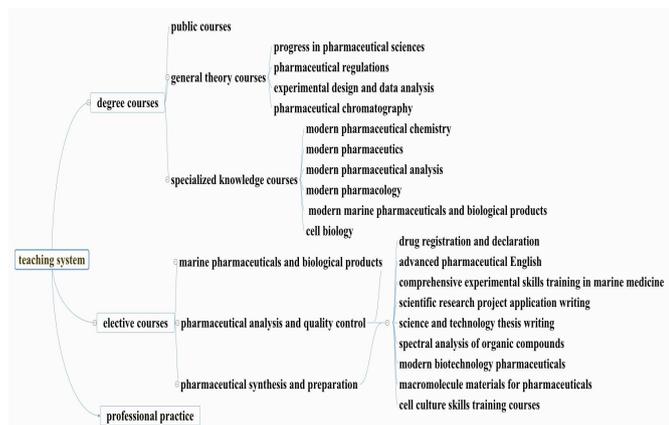


Fig. 1. Teaching system for the professional master of pharmacy

In addition to degree courses, elective courses have been established to train students in drug registration and declaration, advanced pharmaceutical English, comprehensive experimental skills in marine medicine, scientific research project application writing, science and technology thesis writing, the spectral analysis of organic compounds, modern biotechnology pharmaceuticals, macromolecule materials for pharmaceuticals, and cell culture skills. Through it, applied talents can be cultivated, thereby expanding the students' knowledge of the discipline and helping them master professional skills. In that way, students can gain adequate knowledge and skills for practical application in each research dimension, which helps them meet the requirements of the profession at the employment stage, provide high and comprehensive quality service, and apply their knowledge in practice.

III. COURSE DESIGN FOR MARINE PHARMACEUTICALS AND BIOLOGICAL PRODUCTS

Marine organisms constitute a rich source of compounds with diverse structures and biological properties. Marine species account for about half of all life on earth, and the oceans contain tremendous resources for new compounds. Marine pharmaceuticals and biological products mainly use biotechnology, new formulation technologies, and other

technologies to study the application of basic theory and key technologies in the development of marine pharmaceuticals and medical products. The products are rich in active proteins, poly- (oligo)peptides, poly-(oligo)saccharides, and lipids (fish oil), especially natural marine products with unique structures and significant activity. Unique and novel compounds in the ocean have become resources for drug research and development. Leading compounds with biological properties such as anti-cancer, anti-cardiovascular, and anti-cerebrovascular diseases, anti-inflammatory immunity, and anti-oxidation have been screened from marine functional molecules. Their targets and action mechanisms have been explored, and theoretical preparations have been made for the further development of new drugs. Courses for this field of study include modern marine pharmaceuticals and biological products, cell biology, comprehensive experimental skills training in marine medicine, scientific research project application writing, and cell culture skills training. In cell culture skills training, students learn methods to ensure good *in vitro* cell proliferation. Cell culture technology embodies an important part of research on marine active functional molecules. The security and stability of cell cultures can provide a good experimental basis. Therefore, the skills training course of cell culture is an important core skills class in biological technology and professional applications. The course begins by strengthening the students' theoretical foundation from the basic concepts, and then provides a comprehensive introduction to cell culture and helps students to master the basics of it during the process of operation. It consolidates their knowledge of the respective operations, teaches them to find and solve problems, and helps them to apply it in their daily work, thereby providing them with valuable experience and solid skills. Comprehensive experimental skills training in marine medicine and scientific research project application writing are necessary skills for graduate students. The course also teaches scientific paper writing methods, hence cultivating students' ability to implement tests, collect and organize academic information, investigate the capability of test plans and test data processing, and write scientific papers and standardized and specialized theses.

IV. COURSE DESIGN FOR PHARMACEUTICAL ANALYSIS AND QUALITY CONTROL

The establishment and application of methods of drug analysis are the core contents of quality control and drug research and development.[6] Pharmaceutical analysis and quality control focus on the study of drug (functional product) testing methods and quality standards, clinical drug monitoring, drug bio-availability, and the control and assurance of drug quality. The research scope covers the quality control of the drug production process, preparation analysis, clinical drug analysis, *in vivo* drug analysis, drug quality inspection, and other fields. Courses such as modern pharmaceutical analysis, comprehensive experimental skills training in marine drugs, writing of scientific research projects, scientific paper writing, and spectral analysis of organic compounds are set for students in this research dimension. Spectral resolution includes ultraviolet spectrum, infrared spectrum, nuclear magnetic resonance spectrum, and mass spectrum studies. A course for

the identification of the structure of organic compounds, based on the four basic skills of learning spectroscopy and conveying the general analytical methods and processes, provides a basis for drug analysis so as to develop students' spectral analysis skills. Pharmaceutical analysis focuses on the use of chemicals, physical chemistry or biochemistry, and other technical methods to study the chemical structure of a given drug and its preparation and quality control methods. The courses focus on theory with practice; the combination of teaching, studies of the law of drug quality control and methods of designing efficient instruments for the analysis of quality control using modern pharmaceutical analysis technology; and the use of these technologies for drug quality control, thereby relieving shortages (e.g., of drug testing and analysis personnel) at pharmaceutical companies, hospitals, and pharmaceutical factories.

V. COURSE DESIGN FOR PHARMACEUTICAL SYNTHESIS AND PREPARATION

Pharmaceutical synthesis and preparation focuses on research on new technologies and methods of drug chemistry and synthesis; the design, discovery, and construction of compounds with novel structures and good biological activity; and the study of formulation design, production technology, the rational application of pharmaceutical preparations, and the relationship between drug absorption, distribution, metabolism, and excretion. Modern pharmaceuticals, training courses on drug registration and declaration, and modern biotechnology pharmaceuticals have introduced hot areas of pharmaceutical research and development, such as design and optimization technology for pharmaceutical preparations, oral sustained and controlled release technology, targeted drug delivery systems, mucosal drug delivery systems, new drug delivery systems of biological macromolecules, and emulsification technology. By discussing new forms of dosage, new equipment, technologies and excipients, the course enables students to master the basic design principles and mechanisms of pharmaceutical dosage forms, familiarize themselves with the current situation and research ideas on the development of new forms of dosage, understand new developments in pharmacy, and apply them to the further development of new forms of dosage. Students should also master the establishment of the pharmacokinetic model to study process and quality control. Modern biotechnology pharmaceuticals focus on training basic skills of students and developing biopharmaceutical-related theoretical knowledge in research. Students need to master the sources, characteristics, structures, and uses of various biopharmaceuticals. The course pays attention to students' abilities to analyze the process of biotransformation correctly in the light of the actual performance of biological products and to control the quality of products so as to accomplish practical tasks professionally and meet the needs of practical application. Currently, pharmaceutical companies increasingly demand innovative talents in pharmaceuticals. The ultimate goal of practical teaching is to cultivate students' practical abilities and research attitudes in order to develop innovative

talents who have mastered advanced medical science and technology and lay the foundation for their professional abilities in the future.

VI. SUMMARY

Its significance lies in the difficulties of the required knowledge and content structures, due to different research and employment directions. A well-designed curriculum based on three Master of Pharmaceutical Research dimensions: marine pharmaceuticals and biological products, pharmaceutical analysis and quality control, and pharmaceutical synthesis and preparation enables students to master scientific knowledge of modern pharmacy and become familiar with the new trends and recent progress in the field. Personalized education is currently the mainstream and the most efficient method for full-time postgraduate education.

This article demonstrates the importance of the establishment of a curriculum teaching system to talent cultivation and introduces a teaching system for the professional master of pharmacy which could help students to comprehensively master the basic theoretical knowledge of pharmacy, become familiar with the new trends and progress in the field of pharmacy, and comprehensively improve the quality of their self-study skills. More importantly, according to the requirements of the professional training program and the specific situation of each student, the development of a training plan that focuses on pertinence and practicality and considers the actual problems in pharmacy and related fields will cultivate the students' innovative consciousness and ability, hence improving their technical skills and competitiveness in employment. To sum up, the broadly accepted goal of education for master of pharmacy is that foster a group of advanced application-oriented pharmacy graduates.

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