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Preliminary Exploration on the Teaching Reform of Food Microbiology Course with Grain and Oil Characteristics Under the Background of New Engineering

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Abstract: Based on the concept of new engineering construction, this paper explores the teaching reform of the Food Microbiology course aiming at the particularity of the demand for microbiology knowledge in the grain and oil food industry. By analyzing the existing problems in current teaching and combining the training goals of talents with grain and oil characteristics, a "theory-practice-innovation" trinity teaching reform model is proposed. In terms of teaching content, it highlights characteristic content such as grain and oil microbial detection, fermentation, and safety; in terms of teaching methods, it adopts diversified means such as online-offline blended teaching, virtual simulation experiments, and project-based learning; in terms of the evaluation system, it establishes a mechanism combining process evaluation and summative evaluation. Practice shows that this teaching model has effectively improved students' professional literacy and practical ability, providing an effective path for cultivating high-quality applied talents adapting to the development of the grain and oil industry.

Keywords: New engineering; Grain and oil characteristics; Food Microbiology; Teaching reform; Virtual simulation

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1. Introduction

With the in-depth advancement of new engineering construction, higher education is facing new requirements for cultivating innovative, compound, and applied talents [1]. As a core course for food science and engineering majors, Food Microbiology serves as an important bridge connecting theory and practice [2]. However, traditional Food Microbiology teaching has problems such as generalized content, lack of prominent characteristics, and weak practical links, making it difficult to meet the demand for professional talents in the grain and oil food industry.

As an important part of China's food industry, grain and oil food have significant differences in microbiological characteristics from ordinary food [3]. Microbial contamination, fermentation technology, and quality control of grain and oil products all require specialized microbiological knowledge support. Therefore, under the background of new engineering, carrying out the teaching reform of the Food Microbiology course with grain and oil characteristics is of great significance for cultivating high-quality talents adapting to the development of the grain and oil industry.

2. Integration of new engineering concept and grain and oil characteristics

The core of new engineering construction is to cultivate innovative thinking, engineering practice, and interdisciplinary integration capabilities, realizing the transformation from knowledge imparting to ability training, from single discipline to multi-disciplinary intersection, and from closed teaching to open innovation [4]. Due to the special raw material characteristics (grain, oil, etc.), unique processing technology (flour milling, oil pressing, fermentation, etc.), and high quality control requirements (aflatoxin detection, etc.) in the grain and oil food industry, the teaching of grain and oil microbiology must highlight four major characteristics: first, the microbiological characteristics of raw materials, focusing on the composition of microbial communities such as grains and oilseeds and their impact on product quality; second, the control of process microorganisms, emphasizing the prevention and control of microbial contamination during processing and the optimization of fermentation technology; third, safety detection technology, strengthening the rapid detection and risk assessment of microbial toxins; fourth, the application of functional microorganisms, focusing on the application of probiotics, enzymes, etc. in product development.

The integration of the two is the common demand of industry development and education reform: the grain and oil industry is in urgent need of high-quality talents with microbiology knowledge, and the new engineering concept provides theoretical and practical paths for curriculum reform. Through the integration of production and education and school-enterprise cooperation, the combination of theory and practice can be realized, and talents suitable for the industry can be cultivated [5].

3. Analysis of the current situation of the Food Microbiology course

Investigations show that the current course has prominent problems: first, the teaching content is generalized, focusing on general microbiology content, lacking pertinence to grain and oil characteristics; second, the teaching method is single, dominated by teacher lectures, with insufficient interactivity and practicality, resulting in low student participation; third, the practical links are weak, the experimental content is outdated, and disconnected from industry needs; fourth, the evaluation system is imperfect, emphasizing final exams while neglecting process and ability evaluation; fifth, the teacher structure is unreasonable, with teachers lacking industry practical experience and insufficient understanding of the demand for cutting-edge technologies.

The root causes lie in the dominance of traditional educational concepts, slow response to the new engineering concept and industry needs; lagging update of curriculum content and insufficient investment in teaching resources; superficial school-enterprise cooperation, lacking in-depth collaborative mechanisms. With the development of the industry and the advancement of new engineering, curriculum reform is imminent: the industry's demand for microbiology knowledge is more professional and refined, and the application of new technologies, such as molecular biology, is increasingly widespread, making it urgent to update the content

and strengthen the cultivation of innovative practical capabilities. The construction of new engineering has put forward higher requirements for talent cultivation, requiring the cultivation of students' innovative thinking and practical ability.

4. Reform ideas and goals

4.1. Reform ideas

Based on the new engineering concept and grain and oil characteristics, the curriculum reform of Food Microbiology follows the following ideas. Student-centered: focus on students' learning needs and personality development, and stimulate their learning initiative and creativity. Outcome-oriented: clarify the expected learning outcomes of the course and reversely design the teaching content and evaluation methods [6]. Practice-focused: strengthen practical teaching links and cultivate students' engineering practice ability and innovative thinking [7]. Feature-driven: highlight grain and oil characteristics and create a differentiated competitive advantage.

3.2. Reform goals

The curriculum reform of Food Microbiology should include three goals.

(1) Knowledge goal: master the basic theories and cutting-edge technologies of grain and oil microbiology, and have a solid professional knowledge foundation.

(2) Ability goal: possess practical capabilities such as grain and oil microbial detection, analysis, and control, as well as the ability to solve practical problems.

(3) Quality goal: cultivate comprehensive qualities such as innovative thinking, teamwork, and lifelong learning to adapt to the needs of industry development.

5. Specific reform measures

First, restructure the curriculum content. Based on grain and oil characteristics, restructure the curriculum content system to highlight professionalism and pertinence [8]. Second, innovative teaching methods. Adopt diversified teaching methods to improve teaching effectiveness and student participation. Third, further improve the practical system. Construct a three-level practical system of "basic-comprehensive-innovative" to strengthen the cultivation of practical abilities. Fourth, continuously optimize the evaluation mechanism. Establish a diversified evaluation system to fully reflect students' learning effects [9]. Finally, continue to strengthen the construction of the teaching staff. Enhance teachers' professional literacy and practical ability through training. The specific implementation measures are as follows.

5.1. Restructuring of curriculum content

(1) Optimization of theoretical teaching content: add special modules on grain and oil microbiology, including grain microbiology, oil microbiology, fermentation microbiology, etc.; update cutting-edge content, introducing the application of new technologies such as molecular biology and genetic engineering in grain and oil microbiology; introduce typical cases from the grain and oil industry in case teaching sessions, such as aflatoxin contamination incidents and optimization of grain and oil fermentation processes.

(2) Design of practical teaching content: basic experiments to train students' basic microbial operation skills; comprehensive experiments to examine students' understanding and mastery of grain and oil microbial detection and quality control; innovative experiments to cultivate students' research-oriented experimental scientific thinking based on practical problems; virtual simulation experiments to conduct simulation training of complex experiments using virtual simulation platforms [10].

5.2. Innovation of teaching methods

(1) Online-offline blended teaching: conduct basic knowledge explanation, resource sharing, and discussion and communication online; carry out case analysis, experimental operation, and project practice offline; use multiple platforms for joint online teaching to improve teaching efficiency and quality [11].

(2) Project-based learning: design project tasks related to the grain and oil industry, and students complete the projects in teams to cultivate collaboration capabilities and innovative thinking, with project results serving as an important basis for evaluation.

(3) Case teaching method: introduce actual cases from the grain and oil industry, and cultivate students' ability to analyze and solve problems through case analysis; invite industry experts to participate in case teaching to enhance the practicality of teaching.

5.3. Improvement of the practical system

(1) Construct a virtual simulation platform for grain and oil microbial detection to simulate complex experimental environments and process flows, providing a safe and efficient experimental training environment [12].

(2) Establish in-depth cooperative relationships with grain and oil enterprises to set up off-campus internship bases, providing real practical environments; invite enterprise experts to participate in teaching guidance to enhance the pertinence of teaching.

(3) Encourage students to participate in scientific research projects and innovation competitions, support them to carry out innovation and entrepreneurship activities, and cultivate their innovative spirit and entrepreneurial ability.

5.4. Optimization of the evaluation mechanism

(1) Diversified evaluation system: conduct process evaluation through classroom performance, homework completion, and experimental operation; conduct summative evaluation through final exams, project results, and papers; evaluate students' practical ability, innovative ability, and collaboration ability [13].

(2) Multi-subject evaluation: teachers evaluate students' knowledge mastery and ability performance; students reflect on and evaluate their own learning situation; mutual evaluation among students; enterprise experts evaluate students' practical ability.

(3) Dynamic evaluation mechanism: establish student learning files to record learning processes and achievements; regularly collect feedback information to adjust teaching strategies in a timely manner; monitor learning effects through learning analysis technology.

5.5. Strengthening of teaching staff construction

(1) Teacher training and improvement: organize teachers to participate in training on the new engineering concept and grain and oil microbiology; invite industry experts to give special lectures and technical

guidance; support teachers to participate in academic exchanges and further study [14].

(2) Accumulation of industry practical experience: arrange teachers to take temporary positions in grain and oil enterprises; encourage teachers to participate in enterprise scientific research projects and technical research; establish a long-term mechanism for improving teachers' practical ability.

(3) Construction of teaching teams: form teaching teams composed of on-campus teachers and enterprise experts; promote interdisciplinary cooperation to improve the overall level of the team; establish a team collaboration mechanism to realize resource sharing and complementary advantages.

6. Reform practice effects

6.1. Improvement of students' learning effects

Through diversified teaching methods and rich teaching content, students' learning interest has been significantly improved, the number of students participating in classroom discussions and practical activities has increased significantly, and their awareness of independent learning and inquiry learning has been enhanced [15]. Students' mastery of grain and oil microbiology knowledge has become more solid, enabling them to combine theoretical knowledge with practical problems, significantly improving their ability to analyze and solve problems, and their knowledge system has become more complete and systematic. Through virtual simulation experiments and actual project training, students' experimental operation skills have been significantly improved, enabling them to independently design and complete experimental projects. Their innovative thinking and practical ability have been cultivated, and their performance in internships and employment has been excellent, winning praise from employers.

6.2. Improvement of teaching quality

After the reform, students' satisfaction with the teaching content has been significantly improved, their recognition of teaching methods has been remarkably enhanced, and their satisfaction with teaching effects has increased greatly. The passing rate of course assessments has been significantly improved, students have performed excellently in various competitions and scientific research projects, and the employment rate and employment quality of graduates have been significantly enhanced. Teachers' teaching design ability and innovation ability have been obviously improved, their information-based teaching level has been significantly raised, their teaching research ability has been strengthened, and high-quality teaching research papers have been published.

6.3. Enhancement of social recognition

The reformed course is more in line with industry needs and has been highly recognized by industry experts. Graduates have performed more excellently in the grain and oil industry, and employers' satisfaction has improved. The cooperation between the course and grain and oil enterprises has become closer, establishing a good school-enterprise cooperation relationship. The reform experience has attracted widespread attention and recognition from peers, with many universities coming to learn from the reform experience. The curriculum reform achievements have been exchanged and promoted at academic conferences.

7. Conclusion and Outlook

7.1. Conclusion

The teaching reform of the Food Microbiology course based on the new engineering concept and grain and oil characteristics has achieved remarkable results. A "theory-practice-innovation" trinity teaching model has been constructed, effectively improving teaching quality and learning effects. By restructuring the curriculum content system, the grain and oil characteristics have been highlighted, making the teaching content more in line with industry needs. Diversified teaching methods such as online-offline blended teaching and project-based learning have been innovated, stimulating students' learning interest and initiative. A three-level practical system of "basic-comprehensive-innovative" has been established, and students' practical ability has been significantly improved through virtual simulation experiments and school-enterprise cooperation. A diversified evaluation system has been established to fully reflect students' learning effects and comprehensive qualities.

7.2. Existing problems and deficiencies

Despite the remarkable achievements of the teaching reform, there are still some problems and deficiencies. For example, some teachers' understanding of the new engineering concept and grain and oil characteristic teaching is not deep enough, and their teaching design ability needs to be improved; the construction of virtual simulation experimental platforms and the development of high-quality teaching resources require large capital investment, resulting in unbalanced resource allocation; there are certain difficulties in the formulation and implementation of diversified evaluation standards, which need to be further improved; the sustainability and stability of teaching reform need to be further strengthened to establish a long-term mechanism.

7.3. Future outlook

The teaching reform of the Food Microbiology course with grain and oil characteristics based on the new engineering concept is a continuous process. In the future, it is necessary to further deepen the reform in the following five aspects.

(1) Deepen the integration of concepts: further deepen the integration of the new engineering concept and grain and oil characteristics, improve the curriculum system, and enhance teaching quality.

(2) Strengthen resource construction: increase investment, improve the construction of virtual simulation experimental platforms, develop more high-quality teaching resources, and enrich teaching content and forms.

(3) Optimize the evaluation system: further improve the diversified evaluation system, formulate scientific evaluation standards, and improve the objectivity and fairness of evaluation.

(4) Deepen school-enterprise cooperation: deepen cooperation with grain and oil enterprises, establish a closer cooperative relationship, and provide better practical opportunities and employment channels for students.

(5) Promote reform experience: summarize the reform experience to form a replicable and promotable teaching model, providing a reference for the teaching reform of related courses.

8. Closing remark

Under the background of new engineering construction, carrying out the teaching reform of the Food Microbiology course with grain and oil characteristics is an important measure to cultivate high-quality applied talents adapting to the development of the grain and oil industry. Through reform measures such as restructuring

curriculum content, innovating teaching methods, improving the practical system, and optimizing the evaluation mechanism, the teaching quality and learning effects have been effectively improved. In the future, we will continue to deepen the teaching reform, improve the teaching system, cultivate more high-quality professional talents for the grain and oil food industry, and provide useful reference for the teaching reform of related courses.

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Disclosure statement

The authors declare no conflict of interest.

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