

# Exploring of New Model for Cultivating Food Professionals.

## Five-dimensional Synergy, Four-chain Integration, and Tripartite Convergence

Fangfei LI<sup>1,2</sup>, Yangyang CHAI<sup>1,2</sup>, Qun FU<sup>1,2</sup>, Qingqi GUO<sup>1,2</sup>, Yihong BAO<sup>1,2\*</sup>

1. College of Food and Health, Northeast Forestry University, Harbin 150040, China; 2. Heilongjiang Provincial Key Laboratory of Forest Food Resources Utilization, Northeast Forestry University, Harbin 150040, China

**Abstract** Based on the context of the high-quality development of Heilongjiang's grain industry and the national food security strategy, and in response to the current practical dilemmas faced by the traditional talent cultivation model for food science majors such as the disconnect between knowledge structure and industrial demand, insufficient practical ability training, and weak innovation awareness, this study has constructed a new systematic education model characterized by "five-dimensional synergy, four-chain integration, and tripartite convergence". This model addresses the new requirements posed by the development of Emerging Engineering Education for the cultivation of food science professionals. Centered on an industry-education integration community, the model promotes the deep coupling of the "innovation chain, industrial chain, capital chain, and talent chain" through the five-dimensional synergy mechanism of "industry-education, science-education, teachers, teaching materials, and teaching methods". It achieves the integrated development of "industry-education integration, science-education integration, and school-enterprise integration". Practice has shown that this model effectively solves the problems in traditional food science education, such as insufficient interdisciplinary integration, disconnect between industry and education, and weak innovation ability. It provides a replicable reform paradigm for cultivating high-quality composite talents who meet the needs of the modern food industry.

**Key words** Five-dimensional synergy; Four-chain integration; Tripartite convergence; Talent cultivation

**DOI:**10.19759/j.cnki.2164-4993.2026.04.016

Emerging Engineering Education is a major educational reform initiative put forward by the Ministry of Education to proactively respond to the new round of technological revolution and industrial transformation, and to serve national strategies and regional development needs. In 2017, the Ministry of Education issued the *Notice on Launching Research and Practice of Emerging Engineering Education*, marking the official entry into the implementation phase of the development of Emerging Engineering Education. Emerging Engineering Education emphasizes the engineering education philosophy of "student-centeredness, outcome orientation, and continuous improvement", focusing on cultivating interdisciplinary engineering and technological talents with innovative capabilities and cross-disciplinary integration skills<sup>[1]</sup>. Food security is a crucial foundation of national security. As a major agricultural province that has consistently ranked first in both total grain production and commercial grain output for many consecutive years, Heilongjiang Province carries the earnest expectations of General Secretary Xi Jinping to "secure China's food supply and safeguard the granary of a great nation", serving as a key "ballast stone" in ensuring national food security. In recent years, Heilongjiang Province has vigorously promoted the "grain-to-food" and "agriculture-to-industry" projects, driving the transformation of grain processing toward high value-added directions such as intensive processing and green food. Meanwhile, with the in-depth application of new technologies such as biotechnology, artificial

intelligence, and big data in the food sector, China's food industry is undergoing a profound transformation from traditional manufacturing to intelligent manufacturing, and from scale expansion to quality and efficiency improvement. Facing the development demands of the food industry, whose total output value exceeded 15 trillion yuan in 2023<sup>[2]</sup>, industrial transformation poses higher requirements for interdisciplinary talents. There is an urgent need to cultivate interdisciplinary Emerging Engineering talents who are proficient in food scientific principles, skilled in engineering technical methods, and equipped with outstanding innovative and practical abilities.

There are still many prominent problems in the current cultivation of food science professionals that are incompatible with the requirements of Emerging Engineering Education. (1) Disconnection between training objectives and industrial demands: Traditional training programs focus more on theoretical imparting, and lacks the cultivation of engineering practice ability, innovative design ability, and cross-disciplinary integration skills. Graduates find it difficult to quickly adapt to the needs of industrial technology upgrading. (2) The curriculum system and subject development are lagging behind. The course content is updated slowly, and emerging technologies such as artificial intelligence, big data, and intelligent manufacturing are not fully integrated, making it difficult to support the cultivation of interdisciplinary talents. (3) Separation between practical teaching and real-world scenarios: On-campus experiments are predominantly verification-oriented, and enterprise internships tend to be formalistic, leaving students without authentic project training for solving complex engineering problems, resulting in weak engineering practical ability. (4) Dispersal of training entities and resource elements: The collaborative education mechanism among universities, enterprises,

Received: May 27, 2026 Accepted: July 29, 2026

Supported by Education and Teaching Research Project of Northeast Forestry University (DCY2024-17).

Fangfei LI (1993 – ), female, P. R. China, associate professor, devoted to research about food science and engineering.

\* Corresponding author.

research institutes, and government departments is not well-established, and the integration of educational resources with industrial resources is insufficient, failing to effectively form a synergy in talent cultivation.

Exploring a new model for cultivating food science professionals under the context of Emerging Engineering Education is both an inevitable choice to respond to the demands of industrial transformation and an intrinsic requirement for promoting the high-quality development of food science education. The new model for cultivating food science professionals proposed in this study—"five-dimensional synergy, four-chain integration, and tripartite convergence", aims to construct a systematic, collaborative, and integrated new ecosystem for talent cultivation, providing theoretical guidance and practical pathways for the reform of food science education. It holds significant theoretical value and practical relevance.

## Theoretical Basis and Conceptual Construction

### Theoretical basis

In terms of value orientation, Emerging Engineering Education emphasizes engineering ethics, patriotic commitment, and global vision, cultivating new-generation talents capable of shouldering the mission of national rejuvenation. For the cultivation of food science professionals in Heilongjiang Province, it is essential to deeply recognize the strategic significance of "securing China's food bowl". In recent years, Heilongjiang's grain output has accounted for approximately one-ninth of the national total, and its commercial grain supply ranks first in the country. The region is endowed not only with vast black soil, but also with rich resources of the "forest grain reserve". In cultivating food science professionals in Heilongjiang Province, it is first necessary to guide students to establish a sense of mission in "safeguarding the nation's granary", integrate personal development into the national food security strategy, and better practice the principle of "writing papers on the land of the motherland, enabling students to understand the weight of 'China's food bowl' and closely linking professional learning with the protection of national food security".

In terms of ability development, emphasis is placed on engineering practice ability, innovative design ability, and cross-disciplinary integration ability, cultivating outstanding engineers capable of solving complex engineering problems. Emerging Engineering breaks down disciplinary barriers, emphasizes the integration of multidisciplinary knowledge, and cultivates students' adaptability to cope with future technological uncertainties. In terms of model innovation, emphasis is placed on the integration of industry and education, the integration of science and education, and the integration of specialization and innovation, establishing a new open and collaborative educational mechanism. Emerging Engineering calls for breaking down the walls of universities, integrating resources from government, industry, academia, research, and application, and forming an organic connection between the education chain, and the industry chain and innovation chain<sup>[3]</sup>.

System theory holds that a system is an organic whole composed of interrelated and interacting elements with specific functions, and the overall function of the system is greater than the sum of the functions of its individual elements. Synergy theory emphasizes that the synergistic interaction among subsystems within a system can produce a " $1 + 1 > 2$ " synergistic effect. Applying system theory and synergy theory to talent cultivation requires that we regard talent cultivation as an open and complex system, pay attention to the systematic design of elements such as training objectives, curriculum systems, teaching models, and evaluation mechanisms, strengthen the synergy and interaction among entities including government, universities, enterprises, research institutes, and employers, and achieve overall improvement in the quality of talent cultivation through element optimization and mechanism synergy.

### Theoretical framework

Based on the above theories, this study constructs a new concept for food science talent cultivation characterized by "five-dimensional synergy, four-chain integration, and tripartite convergence". (1) "Five-dimensional synergy" refers to the construction of an education community featuring deep collaboration among five stakeholders—government, universities, enterprises, research institutes, and employers, forming a synergistic mechanism of shared training objectives, co-managed training processes, shared educational resources, and joint quality evaluation. (2) "Four-chain integration" refers to the interconnection of the education chain, talent chain, industry chain, and innovation chain, achieving precise alignment between educational supply and industrial demand and mutual promotion between talent cultivation and technological innovation, and forming a virtuous cycle of resonance between education and industry. (3) "Tripartite convergence" refers to the deep integration of three major strategies—industry-education integration, science-education integration, and specialization-innovation integration, systematically transforming industrial resources, research resources, and innovation and entrepreneurship resources into educational resources, and constructing a diversified and integrated practical education system. The three are mutually supportive and organically unified. Five-dimensional synergy serves as the subject guarantee, four-chain integration serves as the pathway mechanism, and tripartite convergence serves as the implementation strategy, together forming a complete logical system for Emerging Engineering talent cultivation in food science.

## Construction of the "Five-dimensional Synergy" Education Community

In the context of the development of Emerging Engineering Education, five parties—government, universities, enterprises, research institutes, and employers, collaborate and interact synergistically. The education administrative departments coordinate top-level design, policy incentives, and quality evaluation, while the science, technology, and industry departments coordinate industrial resources and support guarantees. Universities, as the

main front of talent cultivation, undertake curriculum system development, teaching implementation, and knowledge innovation. Enterprises, as the demand terminal, provide competency standards, real projects, practical platforms, and job resources. Research institutes play a leading role in science and technology, supporting teaching and faculty development with cutting-edge knowledge, research projects, and experimental platforms. Employers participate in the formulation of professional competency standards and promote continuous improvement of training programs through employment tracking and quality feedback, forming a closed-loop collaborative mechanism of "policy guidance—talent cultivation—demand supply—science and technology leadership—feedback and improvement".

The "Five-dimensional synergy" education community constructs a systematic operation mechanism around the five core dimensions, forming a synergy in talent cultivation through subject collaboration and resource integration. First, a "Food Science Talent Cultivation Council" composed of representatives from universities, enterprises, research institutes, government, and industry is established as the highest decision-making body, holding regular joint meetings to coordinate the review of training programs, allocate resources, and address major collaborative issues. Under the Council, specialized working groups are established for program development, curriculum development, and practical teaching guidance, which are responsible for the organization and advancement of specific operational tasks, ensuring that multi-stakeholder participation is effectively implemented. Second, guided by the principle of mutual benefit and win-win outcomes, a multi-stakeholder collaborative interest linkage system is established. In this system, universities gain access to industrial resources and employment channels, enterprises obtain talent reserves and technical support, research institutes expand application scenarios and commercialization pathways, and the government achieves effective talent supply and coordinated industrial development. Through the co-construction of substantive platforms such as industry colleges, joint laboratories, and technology transfer centers, deep resource integration and long-term interest sharing are promoted. Third, a "Food Industry Talent Demand Big Data Platform" is established to dynamically monitor industrial technological transformation, changes in job competency requirements, and graduate employment quality. A five-party information sharing system is established, and regularly publishes the *Food Industry Technology White Paper* and the *Talent Demand Forecast Report*, providing data support and decision-making basis for program establishment, curriculum updates, and training model optimization, thereby enhancing the alignment between talent cultivation and industrial development. Finally, a "five-party participation, multi-dimensional evaluation" talent cultivation quality assurance system is established to achieve full-process closed-loop management. The government conducts macro-level quality monitoring and policy guidance; universities focus on teaching process and educational outcome evaluation; enterprises are responsible

for practical competency assessment; research institutes emphasize research literacy evaluation; and employers track career development quality. The evaluation results from all parties are interconnected and fed back, driving continuous optimization of the training system. Enterprises conduct practical competency evaluation, research institutes evaluate research literacy, and employers track career development quality, forming a full-chain quality closed loop.

## Design of the "Four-chain Integration" Training Pathway

The "four-chain integration" training pathway is designed to address the common problems in traditional food-related talent cultivation, including disconnection from industrial development, insufficient cultivation of innovation capability, rigid knowledge systems, and poor coordination among industry, academia, research, and application. The pathway addresses these issues from four aspects: reconstructing the curriculum system, cultivating capabilities throughout the entire cycle, aligning with industrial chain needs in a reverse manner, and integrating the research-education system<sup>[4]</sup>.

### Reconstruction of the education chain: constructing a curriculum system with Emerging Engineering characteristics

The reconstruction of the education chain is advanced from three aspects. (1) Optimization of the talent-training objective chain: In response to the intelligent, green and healthy development trends of the food industry, the objective of "solid foundation, strong practice, emphasis on innovation and good integration capability" is established to cultivate interdisciplinary talents of Emerging Engineering Education with solid foundations in food science and engineering, intelligent equipment manufacturing technology, innovative design ability and industrial vision. (2) Reconstruction of the curriculum-content chain: Breaking the barriers of traditional disciplines, a five-level curriculum system of "general education + disciplinary foundation + professional core + interdisciplinary expansion + innovative practice" is constructed. Emerging courses such as "Food Artificial Intelligence" and "Food Big Data" are added, and new industrial technologies, specifications and standards are timely integrated into teaching. (3) Innovation of the teaching-method chain: Teaching modes including project-based teaching and case-based teaching are adopted to practice the concept of "learning by doing and doing by learning". Virtual simulation experimental projects are developed to tackle experimental teaching difficulties such as high-risk and high-cost experiments, and open online courses are built to realize the sharing of high-quality educational resources.

### Talent chain development: implementing full-cycle competency cultivation

The development of the talent chain implements full-cycle competency cultivation. The 1<sup>st</sup> and 2<sup>nd</sup> years constitute the fundamental competency cultivation stage, during which students strengthen their foundation in mathematics, engineering fundamentals, and scientific

literacy, and establish an initial understanding of the food industry and engineering practice through cognitive internships, professional orientation courses, and engineering training. The 3<sup>rd</sup> year is the professional competency cultivation stage, focusing on systematic learning of core knowledge in food processing, food machinery, and food testing. Based on curriculum design, comprehensive experiments, and enterprise internships, students' engineering practice ability and problem-solving skills are developed. The 4<sup>th</sup> year is the innovation competency cultivation stage, during which students are encouraged to participate in faculty research projects, enterprise real projects, or college student innovation and entrepreneurship projects, and their innovative design ability and comprehensive application skills are enhanced through the completion of graduation theses (designs). After graduation, students enter the career development stage, during which a graduate career development tracking mechanism is established to provide continuing education, technical training, and career development guidance, which will support lifelong learning and continuous growth.

#### **Industry chain alignment: establishing a "reverse design" mechanism**

Industry chain alignment is advanced through three aspects: demand reverse transmission, synchronous standard updating, and deep process embedding. A reverse design mechanism of "industry needs – competency standards – training objectives – graduation requirements – curriculum system" is established. Through in-depth investigations of food enterprises and industry associations, the job competency requirements at each link of the industrial chain are analyzed and transformed into graduation requirement indicators, which are further refined into course teaching objectives. A dynamic training standard adjustment mechanism is established, with annual revisions to talent training programs based on industrial development and major adjustments every three years. Enterprise experts are invited to participate in syllabus revision, ensuring that teaching content is synchronously updated with industrial technology. Real industrial chain scenarios are fully embedded throughout the entire training process. First-year students are organized for cognitive internships at enterprises to gain an overview of the industry. Second- and third-year students are exposed to real-world problems through enterprise project case teaching. Fourth-year students are arranged to enter enterprises to complete graduation projects and internship programs, which will facilitate their smooth transition from students to engineers.

#### **Innovation chain integration: building a "scientific research-education" system**

The integration of the innovation chain builds a scientific research-education system through three aspects: scientific research platform integration into teaching, scientific research project integration into curriculum, and innovation outcome integration into industry. Scientific research platforms at or above the provincial and ministerial level are opened to undergraduate students, and a research mentorship system is established to enable students to enter laboratories, research groups, and scientific research projects

at an early stage. Research outcomes are transformed into experimental teaching projects, and research methodology training is integrated into course teaching. Scientific research innovation credits are set up to support students in leading or participating in research projects such as the College Student Innovation and Entrepreneurship Training Program and the "Challenge Cup" competition. Enterprise technical problem-solving projects and faculty research projects are broken down into sub-projects suitable for student participation, serving as sources for graduation thesis topics. An incubation and commercialization mechanism for student innovation outcomes is established, in collaboration with technology business incubators and industrial investment funds, to support students in transforming innovation outcomes into startup projects. A "Food Innovation and Entrepreneurship Fund" is also established to fund students in technology entrepreneurship practice.

### **Deepening the Implementation Strategy of "Tripartite Convergence"**

#### **Deepening industry-education integration: building a school-enterprise community with a shared future**

The deepening of industry-education integration and the construction of a school-enterprise community with a shared future are advanced in four aspects. Firstly, the dual professional-leader system for schools and enterprises is implemented. University teachers and enterprise experts serve jointly as program leaders, who collaboratively formulate talent-training standards, develop curriculum resources and build teaching teams to realize the mode of "recruitment as employment and enrollment as factory admission". Secondly, dual-competency-oriented courses are developed. Theoretical modules are delivered by university teachers and practical modules are given by enterprise experts. Co-constructed courses such as *Food Factory Design and Intelligent Food Equipment* are established. Real-world enterprise projects are transformed into teaching cases, and industry-education-integrated textbooks incorporating enterprise technical standards and process specifications are compiled. Thirdly, the enterprise practice system for teachers is set up. Professional teachers are required to accumulate no less than six months of front-line enterprise practice every five years. Enterprise executives and technical backbones are employed as part-time teachers, and the training program for dual-competency teachers is carried out to improve teachers' engineering practical ability. Fourthly, an intelligent food-manufacturing training center is constructed with real enterprise production lines introduced to achieve the goal of "factory-style teaching and teaching-oriented factory operation". Meanwhile, teacher workstations and student internship bases are established within enterprises to build an industry-education integration complex integrating practical teaching, technological research and development, and staff training<sup>[5]</sup>.

#### **Advancing science-education integration: achieving mutual promotion between scientific research and teaching**

Science-education integration achieves mutual promotion

between scientific research and teaching through three aspects: feeding teaching with research outcomes, supporting scientific research via teaching, and sharing platform resources. In terms of feeding teaching with research outcomes, a "three-entry" mechanism is established to introduce research outcomes into textbooks, classrooms, and experiments, which enables incorporating frontier findings into teaching materials, transforming them into teaching instruments, and decomposing research projects into undergraduate innovation training projects. In terms of supporting scientific research via teaching, systematic experimental teaching is used to cultivate students' research thinking, and new issues identified during student participation in research feed back into the adjustment of faculty research directions. Meanwhile, a "research mentor – academic mentor – enterprise mentor" three-mentor system is established to provide comprehensive guidance for student development. The ultimate goal is to respond to the new demands imposed by industrial transformation on the knowledge structure and competency of food science professionals, and to cultivate interdisciplinary Emerging Engineering talents who are proficient in food science principles, master engineering methodologies, and possess strong innovative and practical capabilities.

### **Strengthening specialization-innovation integration: cultivating innovation and entrepreneurship ability**

Innovation thinking and entrepreneurship awareness are systematically integrated into professional courses. Leveraging the advantages of Heilongjiang's grain industry, specialized-innovation integrated courses such as *Food Entrepreneurship Management and Food Product Innovation Design* are offered, and additional modules on deep processing of characteristic Heilongjiang grains and brand operation of cold-region agricultural products are added, to strengthen students' ability to develop and innovatively apply local grain resources. Based on Heilongjiang's grain industry foundation, a food makerspace is established and equipped with hardware facilities such as food pilot-scale production lines and rapid testing equipment, with a focus on supporting research and development of deep processing projects for advantageous grain varieties including corn, soybean, and rice. Cooperation with leading Heilongjiang grain enterprises such as Beidahuang Group, Jiusan Grain and Oil, and Feihe Dairy is deepened, and innovation and entrepreneurship practice bases are jointly established to provide students with real entrepreneurial scenarios, industrial resource connections, and market channel support. A specialized-innovation mentor team composed of professional faculty, entrepreneurship mentors, and entrepreneurs is established, and successful entrepreneurial alumni, especially those in the grain industry sector, are invited to serve as entrepreneurship mentors to share practical experience. A specialized-innovation education teacher training system is established, with regular arrangements for teachers to take temporary posts in major grain-producing areas and enterprises in Heilongjiang to enhance their industrial awareness and teaching competence. Innovation and entrepreneurship outcomes are incorporated into the academic evaluation system, and

patents, competition awards, and entrepreneurial achievements obtained by students are convertible into credits, aiming to encourage innovative projects related to the Heilongjiang grain industry chain.

## **Supporting System and Safeguard Mechanisms**

### **Institutional safeguard system**

An organizational leadership mechanism is established. An Emerging Engineering Education Leading Group is formed, with university leaders serving as the group heads, responsible for overall planning and coordinated advancement of the talent training model reform. The development of Emerging Engineering Education is incorporated into the university's "15<sup>th</sup> Five-Year Plan" and annual key work priorities to ensure the implementation and effectiveness of the reform<sup>[6]</sup>. The institutional regulatory system is improved. Supporting regulations such as the *Administrative Measures for Modern Industry Colleges*, *Standards for Industry-Education Integration Course Construction*, and *Measures for the Recognition of Dual-qualification and Dual-competency Teachers* are formulated to regulate the operation of collaborative education. A flexible personnel management system is established, allowing two-way mobility of teachers between universities and enterprises. A sound quality assurance mechanism is established. A five-level quality monitoring system of "training objectives – graduation requirements – curriculum system – teaching process – learning outcomes" is constructed. Engineering education professional accreditation standards are introduced, and a continuous improvement mechanism is established. Satisfaction surveys of graduates and employers are conducted to serve as the basis for quality improvement.

### **Teaching staff development**

Building a high-quality teaching staff is the core support for deepening industry-education integration and advancing science-education convergence. To this end, the following measures are implemented: a dual-qualification and dual-competency teacher development program is prioritized, with special funds established to support teachers taking temporary posts in enterprises, and enterprise practice experience is incorporated as a mandatory requirement for professional title evaluation. Meanwhile, high-level industry teachers are actively recruited and cultivated, with industry positions established to engage enterprise experts in teaching, so as to promote two-way mobility between universities and enterprises. Furthermore, teachers' educational and teaching ability is continuously enhanced through special training programs of Emerging Engineering Education and the establishment of a teaching development center to provide professional support. These efforts aim to build a professional teaching staff with both solid theoretical foundation and rich practical experience, and to lay a solid foundation for cultivating interdisciplinary food engineering talents through the introduction of industry into teaching and two-way empowerment.

### **Quality evaluation system**

Constructing a scientific and comprehensive quality evaluation

system for Emerging Engineering talent cultivation in food science is a key measure for ensuring talent cultivation quality and promoting continuous optimization of education and teaching. The system is built with multiple evaluation subjects including students, teachers, enterprises, alumni, and society, actively introduces third-party professional accreditation and assessment, and establishes a graduate career development database to track long-term cultivation outcomes. In terms of evaluation methods, the system implements a combination of formative assessment and summative assessment, emphasizes process-oriented assessment, introduces real enterprise projects to evaluate students' ability to solve complex engineering problems, and establishes student learning portfolios to record growth trajectories. The ultimate focus of the evaluation is continuous improvement, with its results serving as important bases for revising training programs, optimizing teaching, and allocating resources. A feedback mechanism is established to timely communicate results to all parties, and the effectiveness of Emerging Engineering Education is incorporated into the performance assessment of departments and faculty<sup>[10]</sup>.

Conclusions and Prospect

The development of Emerging Engineering Education provides a historical opportunity for the reform of food education, but also brings severe challenges. The talent cultivation model proposed in this article, which includes "five-dimensional synergy, four-chain integration, and tripartite convergence", aims to build a diversified collaborative education mechanism, connect the innovation chain of the education industry, and deepen the integration of industry, education, science and technology innovation. The development of Emerging Engineering Education is an ongoing journey. Guided by Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, universities adhere to the fundamental task of fostering virtue through education and continuously deepen educational and teaching reforms. This talent cultivation model aims to cultivate more outstanding engineers for the

highquality development of the food industry, and to thereby make greater contributions to the construction of a strong country in education, science and technology, and talent.

References

[1] WU AH, HOU YF, YANG QB, *et al.* Accelerating development and construction of Emerging Engineering, taking initiative to adapt to and lead the new economy[J]. Research in Higher Education of Engineering, 2017(1): 1–9. (in Chinese).

[2] China National Food Industry Association. 2023 China food industry development report[R]. Beijing: China National Food Industry Association, 2024. (in Chinese).

[3] LIN J. Future-oriented construction of New Engineering Education in China[J]. Research On Education Tsinghua University, 2017, 38(2): 26–35. (in Chinese).

[4] ZHONG DH. Connotation and action of New Engineering construction [J]. Research in Higher Education of Engineering, 2017(3): 1–6. (in Chinese).

[5] GU PH, HU WL, LIN P, *et al.* Outcome-based engineering education model: Practice and exploration of Shantou University[J]. Research in Higher Education of Engineering, 2014(1): 27–37. (in Chinese).

[6] LI ZY. Analysis of the outcome-based concept of engineering education professional accreditation[J]. China Higher Education, 2014(17): 7–10. (in Chinese).

[7] SUN CL. Speech at the national teleconference on deepening vocational education reform[N]. People's Daily, 2019–04–04. (in Chinese).

[8] Department of Higher Education, Ministry of Education. Notice of the General Office of the Ministry of Education on recommending New Engineering research and practice projects[Z]. Document No. [2017]33 of the General Office of the Ministry of Education, 2017. (in Chinese).

[9] WANG YH, ZHAO Z, YANG GM. Exploration of transformation and upgrading paths for food science and engineering programs under the background of New Engineering[J]. Food and Fermentation Industries, 2021, 47(15): 1–6. (in Chinese).

[10] JIANG ZQ, LIAO XJ, HU XS, *et al.* Strategic research on the development of food science and engineering discipline towards 2035[J]. Journal of Chinese Institute of Food Science and Technology, 2022, 22(1): 1–12. (in Chinese).

Editor: Yingzhi GUANG

Proofreader: Xinxiu ZHU

(Continued from page 69)

[14] MA HT, HSIEH JF, CHEN ST. Anti-diabetic effects of *Ganoderma lucidum*[J]. Phytochemistry, 2015, 114: 109–113.

[15] LI S, ZHANG B. Traditional Chinese medicine network pharmacology: Theory, methodology and application[J]. Chin J Nat Med, 2013, 11(2): 110–120.

[16] HOPKINS AL. Network pharmacology: the next paradigm in drug discovery[J]. Nat Chem Biol, 2008, 4(11): 682–690.

[17] KIBBLE M, SAARINEN N, TANG J, *et al.* Network pharmacology applications to map the unexplored target space and therapeutic potential of natural products[J]. Nat Prod Rep, 2015, 32(8): 1249–1266.

[18] RAMASAMY R, YAN SF, SCHMIDT AM. Receptor for AGE

(RAGE): Signaling mechanisms in the pathogenesis of diabetes and its complications[J]. Ann N Y Acad Sci, 2011, 1243: 88–102.

[19] BIERHAUS A, HUMPERT PM, MORCOS M, *et al.* Understanding RAGE, the receptor for advanced glycation end products[J]. J Mol Med, 2005, 83(11): 876–886.

[20] MANNING BD, TOKER A. AKT/PKB signaling: Navigating the network[J]. Cell, 2017, 169(3): 381–405.

[21] KITCHEN DB, DECORNEZ H, FURR JR, *et al.* Docking and scoring in virtual screening for drug discovery: Methods and applications[J]. Nat Rev Drug Discov, 2004, 3(11): 935–949.

[22] BAE LL JB, WALTERS MA. Chemistry: Chemical con artists foil drug discovery[J]. Nature, 2014, 513(7519): 481–483.