

**FEEDBACK**  
from the official opponent  
**for dissertation work of Deng Chunli**  
**«TECHNOLOGY OF PHYSICALLY MODIFICATION OF POTATO STARCH**  
**AND THEIR APPLICATIONS IN FOOD PRODUCTS»**,  
submitted for obtaining the scientific degree of Doctor of Philosophy  
for Specialty 181– Food Technology

Dissertation work presented for obtaining the scientific degree of Doctor of Philosophy is submitted for consideration. The dissertation consists of an introduction, 5 sections, conclusions, a list of references of 236 names, appendices. Main content dissertation is laid out 184 pages of printed text, contains 51 tables and 45 figures.

***Relevance of the dissertation topic***

According to the Food and Agriculture Organization of the United Nations (FAO) data, potatoes were cultivated in 157 countries and regions with a total planting area of 16.49 million hectares and a total output of 359 million tons in 2020. In 2020, the potato production in Asia accounted for 49.7% of the global potato production, while the potato production in Europe accounted for 30%. Starch is the main component of potato tubers and the starch content varies with cultivar and plant growth stage, generally accounting for 66-80% of the dry weight basis. Potato starch is extensively utilized as food ingredients, thickeners, excipients or pharmaceutical fillers in variety food systems. However, native potato starch exhibits poor shear and heat resistance, poor water solubility and thermal stability, which limits the application of starch. Various chemical, enzymatic and physical methods or their combinations have been used to overcome the inherent shortcomings of native starch in order to acquire suitable properties for special applications. Considerable interests in physical modification methods to have been generated due to absence of chemical contamination, food safety, environmental friendliness and low cost of production. Heat-moisture treatment (HMT) and microwave treatment (MW) are the most appealing physical modification methods of starch. HMT and MW directly affects starch digestibility through the formation of slowly digestible starch and resistant starch and the reduction of rapidly digestible starch, which is very important for realizing consumers' health benefits.

During the past ten years, the prevalence of diabetes in Chinese adults has been maintaining at 10%. An analysis of a China nationally representative survey shows that China has more than 130 million adults with type 2 diabetes, and 350 million individuals with prediabetes. Therefore, it is a feasible strategy to develop functional foods products with reduced glycemic index to solve these health problems, and adding modified starch rich in slowly digestible starch and resistant starch in food is one of the effective methods. Since most of the wheat products belong to high glycemic index foods, enhancing food products with functional components has the potential to be beneficial. Strategies for developing food products with low glycemic index remain to be developed to help people with diabetes and other diseases. Partial

substitution of wheat flour with whole flour or other functional ingredients can enhance the nutritional quality of food products. However, the dough rheological properties and the product quality may be altered by substitution of wheat flour with other types of low-gluten flour. Therefore, it is necessary to investigate the effects of substitution of wheat flour with other types of low-gluten flour (i.e. modified starch) on the quality characteristics of dough and the final products.

Thus, the dissertation thesis by Deng Chunli, which was carried out in the direction of enriching slowly digestible starch and resistant starch content products with potato starch modified by HMT and MW in order to provide usefulness, reduce caloric content, and increase nutritional value, is relevant, timely and promising for continuation.

### ***Connection of work with scientific programs, plans, themes***

Scientific research was carried out within the framework of the thematic plan of research works according to topic 0119U103484 "Scientific grounding and development of technologies of food and culinary products using innovative types of raw materials", Department of Food Technology, Sumy National Agrarian University (Ukraine), and the College of Food and Biological Engineering, Hezhou University (China). The work was financially supported by Middle aged and Young Teachers' Basic Ability Promotion Project of Guangxi (grant number 2021KY0710).

### ***The validity of scientific statements, conclusions and recommendations formulated in the dissertation***

The purpose and tasks of the work, aimed at its achievement, correspond to the general plan of theoretical and experimental research. The scientific propositions formulated by the doctoral student and the conclusions given in the dissertation thesis are based on the results of an analytical analysis of the literature and experimental studies performed using instrumental methods - sensory, physicochemical, chemical, computational and statistical. The logic of the presentation of the material corresponds to the set purpose and tasks of research.

The aim of the dissertation thesis is to develop technology of physically modified starches with heat-moisture treatment (HMT) and microwave treatment (MW) and investigate the effects of their application in the production of food products

The doctoral student investigated the effects of single HMT conditions on physicochemical properties, structural and digestion characteristics of potato starch and optimized the modification process of potato starch by single HMT using Box-Behnken response surface methodology. The doctoral student also investigated HMT combined with MW pre- and post-treatment on physicochemical, structural and digestive properties of potato starch. The information obtained in research presented a comprehensive understanding of the effects of single HMT, HMT and MW bi-directional modifications on functional and digestibility properties of starch, as well as the related mechanism, which would provide a useful theoretical basis for further studies on improving the application of hydrothermal and microwave technology in starch modification. Moreover, The doctoral student investigated the effects of partial

substitution of wheat flour with modified potato starch on the quality of cookies, fresh noodles, steamed bread and evaluated of the efficiency of implementation of the results of scientific and technical developments in production.

### ***Validity and novelty of research results***

The scientific novelty of research is inherent in all sections of the dissertation thesis. The scientific novelty of the obtained results is: based on theoretical and experimental studies, it was proven that potato starch modified by HMT, HMT in combination with MW technologies is a significant source of slowly digestible starch and resistant starch; improvement of the technological scheme of cookies, fresh noodles and steamed bread technologies with the addition of potato starch treated with HMT or MW processing is scientifically substantiated.

*For the first time the author:*

– systematically analyzed the viscosity properties, gel textural properties and *in vitro* digestion characteristics of single HMT modified starch and HMT and MW bi-directional modified starch and provided reliable evidence for their application in food industry.

– substantiated the regularities of the effects of wheat flour substitution with modified potato starch on properties of mixed dough and quality of cookies, steamed bread and noodles.

– confirmed that adding a suitable dose of modified potato starch can improve the quality of the products, making the products have good texture properties and sensory acceptability, which is of positive significance for promoting the process of potato staple food.

### ***Practical significance of the obtained results***

The practical component of the dissertation thesis consists of the selection of methods of physical processing of potato starch, with the help of which the desired physicochemical properties of potato starch is achieved, while the content of slow digestion starch and resistant starch can be increased, as well as in the improvement of technological methods of conducting the cookies, fresh noodles and steamed bread production process.

Based on the results of theoretical and experimental research, HMT and MW technology for processing potato starch was developed, which was used to prepare cookies, fresh noodles and steamed bread. The improved technology of cookies, fresh noodles and steamed bread with modified potato starch was implemented at Hezhou Xianhe Health Technology Co., Ltd.

The materials of the dissertation thesis were used in the educational process for preparing students - in the teaching of lecture material, laboratory classes, and the preparing educational and methodical materials.

### ***Complete presentation of the main results of the dissertation***

The main results of the thesis are presented in 5 (five) abstracts of scientific conference reports and 9 (nine) scientific journal articles, 2 of which are published in

a category B scientific professional publication approved in Ukraine and 2 in a scientific professional publication approved in Ukraine indexed by Scopus, 1 publication in a Polish scientific journal indexed by Web of Science, 1 publication in Slovakia scientific journals indexed by Scopus, 2 in Hungarian scientific journals, 1 publication in a Brazil scientific journal indexed by Scopus.

### *Articles in scientific and professional publications of Ukraine*

1. Chunli Deng, Oksana Melnyk, Yanghe Luo. EFFECT OF DIFFERENT HEAT MOISTURE TREATMENT CONDITIONS ON POTATO STARCH PHYSICOCHEMICAL PROPERTIES. *Journal of Chemistry and Technologies*, 2022, 30(1), pp.139-150. <http://chemistry.dnu.dp.ua/issue/view/15177> (Scopus, Q4) (The applicant participated in research, analysis of the results and writing the article)

2. Chunli Deng, Oksana Melnyk, Yanghe Luo. OPTIMIZATION OF HEATMOISTURE TREATMENT ON POTATO STARCH AND STUDY ON ITS PHYSICOCHEMICAL PROPERTIES. *Technology Audit and Production Reserves*, 2022, 3(3(65)), pp., 43-49. <http://journals.uran.ua/tarp/issue/view/15640> (The applicant participated in research, analysis of the results and writing the article)

3. Chunli Deng, Oksana Melnyk, Yanghe Luo. Effects of microwave and heat-moisture treatments on color characteristics, particle size and water distribution of potato starch, *Ukrainian Journal of Food Science*. 2021,9(2), pp.156-166. <https://doi.org/10.24263/2310-1008-2021-9-2-4> (The applicant participated in research, analysis of the results and writing the article)

4. Chunli Deng, Oksana Melnyk, Yanghe Luo. INFLUENCE OF SUBSTITUTION OF WHEAT FLOUR WITH MODIFIED POTATO STARCH ON THE QUALITY OF CHINESE STEAMED BREAD, *Eastern-European journal of enterprise technologies*. 2022, 5/11(119), pp. 12-27. <http://journals.uran.ua/eejet/article/view/265234> (Scopus, Q3) (The applicant participated in research, analysis of the results and writing the article)

### *In foreign scientific journals*

5. Chunli DENG, Oksana MELNYK, Yanghe LUO. Substitution of wheat flour with modified potato starch affects texture properties of dough and the quality of fresh noodles. *Food Science and Technology (Campinas)*, 2023, 43, e128222. <https://doi.org/10.1590/fst.128222> (Scopus, Q2) (The applicant participated in research, analysis of the results and writing the article)

6. Chunli Deng, Oksana Melnyk, Tatyana Marenkova, Yanghe Luo. Modification in Physicochemical, Structural and Digestive Properties of Potato Starch During Heat-Moisture Treatment Combined with Microwave Pre- and Post-Treatment. *Polish Journal of Food Nutrition Science*, 2022, 72(3), pp. 249- 261. <https://doi.org/10.31883/pjfns/151566> (Scopus, Q2) (The applicant participated in research, analysis of the results and writing the article)

7. Chunli Deng, Oksana Melnyk, Yanghe Luo. EFFECT OF PARTIAL SUBSTITUTION OF LOW GLUTEN FLOUR WITH MODIFIED POTATO STARCH ON THE QUALITY OF COOKIES. *The scientific heritage*, 2022, 87(1), pp.42-47. <http://www.scientific-heritage.com/wp-content/uploads/2022/04/The->

scientific-heritage-No-87-87-2022-Vol-1.pdf (The applicant participated in research, analysis of the results and writing the article)

8. Chunli Deng, Oksana Melnyk, Yanghe Luo. THE EFFECT OF HEAT-MOISTURE TREATMENT CONDITIONS ON THE STRUCTURE PROPERTIES AND FUNCTIONALITIES OF POTATO STARCH. *Potravinarstvo Slovak Journal of Food Sciences*, 2021,15, pp.824-834. 12 <https://doi.org/10.5219/1647> (Scopus, Q3) (The applicant participated in research, analysis of the results and writing the article)

9. Deng Chunli, Shang Feifei, Liu Yan, Melnyk O., Luo Yanghe. RECENT ADVANCES IN MODIFICATION OF STARCH AND ITS APPLICATIONS IN CHINA FOOD INDUSTRY, *The scientific heritage*, 2020, 47(1), pp.19-26. <http://www.scientific-heritage.com/wp-content/uploads/2020/09/VOL-1-No-47-47-2020.pdf> (The applicant participated in research, analysis of the results and writing the article)

### *Abstracts of reports*

10. Chunli Deng, Yanghe Luo, Melnyk O. EFFECT OF HEAT MOISTURE TREATMENT ON TEXTURAL PROPERTIES OF POTATO STARCH. II International Scientific and Practical Conference «The world of science and innovation», London, United Kingdom, September 16-18, 2020, pp.40. (The applicant participated in research, analysis of the results and writing the article)

11. Chunli Deng, Yanghe Luo, Melnyk O. EFFECT OF HEATMOISTURE TREATMENT REACTION CONDITIONS ON THE PASTING PROPERTIES OF POTATO STARCH. II International Scientific and Practical Conference «Topical issues of modern science, society and education», Kharkiv, Ukraine, September 5-7, 2021, pp.120. (The applicant participated in research, analysis of the results and writing the article)

12. Chunli Deng, Yanghe Luo, Melnyk O. EFFECT OF HEATMOISTURE TREATMENT REACTION CONDITIONS ON PARTICLE SIZE DETERMINATION OF POTATO STARCH. III International Scientific and Practical Conference «Modern scientific research: achievements, innovations and development prospects», Berlin, Germany, August 29-31,2021, pp.53. (The applicant participated in research, analysis of the results and writing the article)

13. Deng Chunli, Luo Yanghe, Melnyk O. The effect of heat-moisture treatment on digestive properties of potato starch. II International Scientific and Practical Internet Conference «Informational and innovative technologies in hotel and restaurant business, tourism and design», Dnipro – Opole, December 1-2, 2021. pp.33. (The applicant participated in research, analysis of the results and writing the article)

14. Chunli Deng, Melnyk Oksana, Yanghe Luo. EFFECT OF PARTIAL SUBSTITUTION OF LOW GLUTEN FLOUR WITH MODIFIED POTATO STARCH ON THE COLOR AND TEXTURE PROPERTIES OF COOKIES. VI International Scientific and Practical Conference «MODERN RESEARCH IN WORLD SCIENCE», Lviv, Ukraine, 4-6 September 2022, pp.141-147. (The applicant participated in research, analysis of the results and writing the article)

The published works sufficiently reflect and confirmed the conducted research.

***Conclusion on compliance of the dissertation work with the requirements of the procedure for obtaining a scientific degree***

The dissertation thesis of Deng Chunli is an independent, completed qualifying scientific work, relevant, aimed at developing technology of physically modified starches with heat-moisture treatment (HMT) and microwave treatment (MW) and investigate the effects of their application in the production of food products. The work contains new scientifically based results and corresponds to specialty 181 - "Food technologies".

In terms of content, scope of research, scientific novelty, practical significance and design, the dissertation work «TECHNOLOGY OF PHYSICALLY MODIFICATION OF POTATO STARCH AND THEIR APPLICATIONS IN FOOD PRODUCTS» meets the requirements of clauses 9, 10, 11 "The procedure for conducting an experiment for awarding the degree of Doctor of Philosophy ", approved by the Resolution of the Cabinet of Ministers of Ukraine N 167 on March 6, 2019, and its author, Deng Chunli, deserves to be awarded the scientific degree of Doctor of Philosophy in specialty 181 "Food Technologies"

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