REVIEW

official reviewer Bolhova Natalya, Ph.D., Associate Professor

for the dissertation work of a graduate student Deng Chunli on the topic "Technology of physically modification of potato starch and their applications in food products", which is presented for obtaining the degree of Doctor of Philosophy in specialty 181 "Food Technologies", field of knowledge 18 - Production and Technologies.

1. Relevance of the research topic

An urgent issue is the improvement of the technology of physically modified potato starch and its use in the production of food products, namely, cookies, steamed bread and noodles.

Starch is the main component of potato tubers with a starch content of 66-80% of dry weight. It is widely used as a food ingredient, thickener, filler, stabilizer of various food systems. Its unique properties: viscosity, ability to swell, high transparency of starch paste, ability to form thick viscoelastic gels upon heating and subsequent cooling are determined by the size of starch granules and the type of starch.

Due to the fact that native potato starch has low shear resistance, low water solubility and is not resistant to high and low temperatures, interest in its physical modification has increased. This is due not only to obtaining the desired characteristics, but also to the absence of chemical pollutants, food safety, environmental friendliness and low cost.

Today, healthy eating is no longer a trend, but a way of life. That is why great attention is paid to the development of food products with a low glycemic index, with an increased content of slowly digestible and non-digestible substances, which are close to dietary fibers in terms of their physiological effect in the human body. Therefore, the development of new types of modified starch with specified properties and the study of the impact of replacing wheat flour with modified starch

on the structural and mechanical characteristics of the dough, on the functionality and digestibility of the finished products are quite relevant.

2. Connection of work with scientific programs, plans, topics

The work was carried out in accordance with the main directions of scientific research of the Department of Food Technology of Sumy National Agrarian University (Ukraine) 0119U103484 "Scientific grounding and development of technologies of food and culinary products using innovative types of raw materials" and the College of Food and Biological Engineering of Gezhou University of China.

3. The purpose and objectives of the research

The aim of the dissertation is development and scientific substantiation of the technology of physically modified starches, obtained by the method of wet-thermal microwave processing, and their use in the production of food products (biscuits, noodles, steamed bread).

To achieve the main goal, it was necessary to solve a number of interrelated tasks:

- to investigate the effect of moisture-thermal treatment conditions on the physico-chemical properties of starch, namely, the ability to swell, solubility, resistance to freezing-thawing, transparency and textural properties, the ability to retrograde starch paste;

- to investigate the influence of moisture-thermal treatment conditions on the structural characteristics of potato starch, viscosity, particle size, morphological properties, crystalline structure and digestibility in vitro;

- to optimize the process of modification of potato starch by the method of moisture-thermal treatment using the methodology of the appropriate surface of Box-Behnken;

- to investigate the influence of wet-thermal treatment in combination with before and after microwave treatment on the physico-chemical properties of potato starch (color, particle size, water distribution, swelling ability, solubility) and the properties of starch pastes (freeze-thaw stability, ability to retrograde, transparency and textural properties);

- to design the recipe and develop the technology of various food products (steamed bread, cookies, noodles) using modified starches;

- to investigate the effect of partial replacement of wheat flour with modified potato starch on the quality of cookies, steamed bread, noodles, namely the structural and mechanical properties of the dough and the quality (color and sensory perception, digestibility, glycemic index) of the finished products.

Object of study - technology of modification of potato starch by heat-moisture treatment and microwave treatment and its application in food products.

Subject of study -properties of the modified potato starch obtained by the method heat-moisture processing and microwave processing; properties of dough for cookies, noodles and bread made by incorporating modified potato starch; properties of cookies, bread and noodles with the addition of modified potato starch.

4.Scientific novelty of the obtained results

The expediency of the production of physically modified potato starch and its use in the production of cookies, steamed bread, and noodles has been scientifically substantiated and experimentally proven. As a result of the research, for the first time, there was:

1. feasibility has been provenapplication of single HMT and double HMT modification in combination with MW pre- and post-treatment in the production of modified starches;

2. systematically analyzedviscosity, textural properties of starch paste *in vitro*, the feasibility of using modified starch in the production of food products has been proven;

3. the replacement of wheat flour with modified potato starch in the recipe of cookies, steamed bread and noodles is substantiated;

4. recipes for cookies, noodles, and steamed bread were developed and establishedpositive effect of additionof modified potato starch on the properties of dough and finished products (texture, sensory characteristics).

5. Practical significance of the obtained results

Based on the results of theoretical and experimental research the industrial technology for the production of modified potato starch has been improved. The recipes of cookies, steamed bread and noodles with the addition of the obtained modified starch were studied, a technological scheme for the production of cookies, steamed bread and noodles was developed, and the necessary technological documentation (TU and TI) was prepared.

The results of the dissertation can be used in the educational process when studying the disciplines "Theoretical foundations of food production", "General technologies of food production", "General technologies of starchy food products", as well as during the conduct of fundamental and applied research in the direction of the development of technologies for flour products or processing starch raw materials.

6. Theoretical and practical significance of the results of the dissertation

Dissertation work is essential for the further development and scientific substantiation of innovative technologies of the industry. It has been proven that due to adding 15-30% of modified starch (HMTS or MWS), the physico-chemical and structural characteristics of the developed products improved. Studies of postprandial blood glucose levels in consumer participants indicated that products with added HMTS or MWS starch had a lower glycemic index and were more suitable for diabetics and the elderly.

7. Use of work results

The results of the research were implemented at the enterprisein China (Hezhou Xianhe Health Technology Co., Ltd.) with the corresponding economic effect, which is confirmed by the relevant Acts of implementation. Based on the results of the work, technical conditions for modified potato starch (physical modification) (ТУ У 00383403.001:2023 dated 10.05.2023) and TI for cookies, noodles and steamed bread were developed and implemented.

8. The author's personal participation in obtaining the scientific and practical results presented in the dissertation

The personal contribution of the recipient consists in planning the experiment, organizing and conducting analytical and experimental research in laboratory and production conditions, analysis, processing and generalization of results, formulation of conclusions and recommendations, preparation of materials for publication, development and approval of regulatory documentation, implementation of new technologies in production.

Approbation of the scientific and practical results presented in the dissertation was carried out by the applicant personally with the methodological and scientific support of the scientific supervisor Ph.D., Assoc. Melnyk O.Yu.

In the published works, printed in co-authorship, individual theoretical developments, setting up and conducting of all experimental studies, processing of the obtained results, scientific analysis of research results, formulation of conclusions and proposals belong to the doctoral student.

9. List of publications on the topic of the dissertation with an indication of the personal contribution of the recipient

The results of the author's theoretical and experimental research, the main scientific propositions and conclusions of the dissertation are sufficiently covered in9 articles in scientific journals included in the List of scientific specialized publications, Web of Science Core Collection, Scopus and Web of Science Core Collection publications and in 5 abstracts of reports at international conferences.

10. List of publications of the recipient on the topic of the dissertation, which meet the requirements of clause 8."The procedure for awarding the degree of Doctor of Philosophy and canceling the decision of the one-time specialized academic council of the institution of higher education, scientific institution on awarding the degree of Doctor of Philosophy", approved by the Resolution of the Cabinet of Ministers of Ukraine dated January 12, 2022 No. 44

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, September 4-6, 2022, pp. 141-147. (The applicant participated in research, analysis of the results and writing the article)

12. Structure and scope of the dissertation

The thesis consists of an abstract, an introduction, 5 chapters, conclusions, a list of used sources in the number of 236 references and appendices. The main

content of the thesis is presented on 169 pages of printed text, which is well illustrated with tables and figures.

13. Evaluation of the language and style of the dissertation

The dissertation is written in competent English, has meaningful integrity, consistency and completeness. The style of presentation of the material corresponds to that accepted in the scientific literature.

14. The degree of maturity of the acquirer

During his graduate studies and dissertation work, he demonstrated a high level of scientific training, knowledge of the "Food Technologies" specialty, the ability to formulate and solve scientific problems, and outline the ways of their practical implementation. Deng Chunli has the ability to analyze and synthesize scientific knowledge and formulate substantiated conclusions, possesses modern methods of experimental research, packages of special programs for calculating the results of experiments.

In general, Deng Chunli can be characterized as an enterprising, hard-working, persistent, well-rounded scientist.

15. Remarks and wishes on the dissertation work

1. Was the potato variety taken into account during the research? If so, what varieties were used?

2. The paper states that steamed bread obtained with the addition of modified starch had a firmer and denser structure. How desirable is this consumer characteristic?

3. Why did you choose the method of heat treatment of steamed bread and did you conduct a study of the properties of bread baked in the oven in the classic way?

The above comments and wishes on the dissertation work are not fundamental and do not reduce the overall positive assessment of the work.

Conclusion

Dissertation work graduate students Deng Chunli submitted for obtaining the degree of Doctor of Philosophy in the specialty 181 "Food Technologies" according to the signsscientific novelty, theoretical and practical significance of the obtained

results in fullmeets the requirements of the "Procedure for awarding the degree of Doctor of Philosophy and annulment of the decision of the one-time specialized academic council of the institution of higher education, scientific institution on awarding the degree of Doctor of Philosophy", approved by Resolution No. 44 of the Cabinet of Ministers of Ukraine dated January 12, 2022 and the direction of scientific research of the educational and scientific training program Doctor of Philosophy of the Sumy National Agrarian University. The author of the work Deng Chunli deserves to be awarded the scientific degree of Doctor of Philosophy in the specialty 181 Food Technology.

Reviewer:
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