Response

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for a dissertation **(Liu Yan)** «Technology of semi-finished product from dried beetroot, pretreated by freeze-thaw method and food products using it», applied for the degree of Doctor of Philosophy from the field of knowledge (18) by specialty (181)

1. Relevance of the topic of the dissertation.

The production of semi-finished products from vegetables occupies an important place in providing the population with natural food products throughout the year. Therefore, vegetable products are widely used in restaurants. However, for their use, it remains important to reduce the loss of this raw material, thanks to their use in the form of dried semi-finished products.

One of these vegetable products is table beet. Table beets contain a huge amount of biologically active compounds that can be used as ingredients for functional food, including for medical and preventive purposes.

The modern food market requires a constant expansion of the range of semi-finished products, with the introduction of products that can be classified as preventive and dietary. The busy rhythm of life of the population, the urbanization of social life, the associated shortage of time for the active population to prepare food, the need to develop products with a short cooking cycle.

A convenient form of such products is the use of dried products, which are quite affordable, light, nutritious and do not require special storage conditions.

In this context, the search for methods of rationalization of the drying process can be solved in two main ways: improvement of drying methods and development of methods of preliminary preparation of manufactured products for drying.

Therefore, the development of methods of drying and preliminary processing of vegetable products from table beet with further use in the production of sausages and confectionery is an urgent task that is solved by the dissertation work.

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

The dissertation work was carried out in accordance with the plans of research work of the Sumy national agrarian university on two research topics of the department of technology and food safety: 0119U101237 "Innovative technological solutions in the production of food products" and 0122U201635 "Development of technical documentation for semi-finished products from plant raw materials of increased biological value for dual purpose". Scientific research of the dissertation work was carried out on the basis of the Department of Food and Bioengineering, Hezhou University (China).

3. Scientific novelty of the obtained results.

On the basis of analytical and scientific-experimental research, the dissertation for the first time:

– experimentally obtained a complex of data on the effect of different drying methods on quality indicators of table beet;

– the effect of various drying methods, namely heat pump drying (HPD), vacuum drying (VD), freeze drying (FD), microwave drying (MD), microwave vacuum drying (MVD) on the physical properties, bioactive compounds, and antioxidant capacity of dried beet;

– it was established that microwave vacuum drying is the optimal microwave method of drying beets, which is confirmed by the indicators of ready-made dried products;

– it was established that the best parameters of the microwave vacuum drying process are the use of sliced beets with a thickness of 5 mm, using a drying

temperature of 65 °C, with a loading density of the drying working area of 2.0 kg/m2;

– studied the effect of cryogenic processing at different minus temperatures in the range from minus 4 to minus 80 °C and thawing methods using on the functional and technological characteristics, physical properties, bioactive compounds and antioxidant capacity of dried table beets;

– it has been proven that one-time freezing and thawing of table beets at a temperature of minus 20 °C is the most rational way of preparing table beets for drying;

– a complex of new data was obtained characterizing the chemical composition, organoleptic, microbiological and toxicological indicators, nutritional value, and the storage conditions and terms of the developed sausage products based on chicken meat and confectionery products (biscuits with low fiber content) using semi-finished products with freeze-thaw dried beets.

4. Scientific and practical significance.

On the basis of the conducted research, a semi-finished product from freeze-thaw dried table beet with a high content of bioactive compounds, antioxidant activity and improved physicochemical properties was developed for its further use in the technology of sausage products based on chicken meat and biscuits using wheat flour with a low gluten content, which increases the nutritional and biological value, as well as has a positive effect on the physico-chemical, structural-mechanical and organoleptic characteristics of these food products.

The results of the dissertation can be used in the educational process when studying the disciplines "Fundamentals of physiology and food hygiene", "Nutritionology", "Quality and safety of food products", "General technologies of food production".

The obtained research results can be used in conducting further fundamental and applied research in the direction of food technologies.

5. Completeness of presentation of the dissertation material in scientific publications.

The results of the dissertation are reflected in 18 printed works, including: 5 articles in scientific publications by specialty, included on the date of publication in the list of scientific specialized publications of Ukraine, 5 articles in periodical scientific publications, which are indexed in the Scopus / Web database of Science Core Collection , 3 of which are in the journal of the 3rd quartile **(Q3)**, 2 of which are in the journal of the 4th quartile **(Q4)**, 8 abstracts of reports at scientific, scientific-practical and international conferences, 2 of which are indexed in the database Scopus/Web of Science Core Collection.

6. The degree of validity of scientific statements.

The main scientific propositions and conclusions presented in the dissertation are logical, well-founded and made on the basis of reliable, multi-faceted research.

Research tasks were developed on the basis of a thorough analysis of 191 literary sources and own research. To achieve the goal of the dissertation, the author presented a step-by-step plan for conducting experimental work developed at a high scientific level.

Sensory, structural-mechanical, microbiological methods, as well as methods of mathematical modeling and mathematical-statistical processing of results were used during research.

Comprehensive solution of the tasks, modern and comprehensive experiment and analysis of the obtained results, industrial approbation of the proposed technological solutions and extensive discussion of research results at scientific conferences and in publications allow us to conclude about a high degree of validity of scientific statements and reliability of research results.

7. The structure and content of the dissertation, its completeness and compliance with the established requirements for design.

The dissertation consists of an abstract, an introduction, five chapters, conclusions, a list of used literary sources and appendices. The dissertation is presented on 201 pages of the main text, which includes 64 tables, 37 figures, in addition, it contains 22 pages of references to literary sources, 16 appendices on 135 pages.

In the dissertation work, the rules of planning and conducting scientific research are followed, and modern methods of research and processing of experimental results are used. The scientific novelty of the results of the work is based on own research, which was used at the appropriate level with the use of generally recognized research methods.

The dissertation is written in English and Ukrainian. The style and presentation of the work is logical, consistent and meets the requirements for printed works. The content of the work presents the results of scientific research and their approbation in practice. When presenting the text, mostly modern scientific terminology is used.

The dissertation is a completed scientific work, in which the optimal combined method of obtaining a semi-finished product from frozen-thawed table beet dried using microwave vacuum drying and the method of preliminary preparation - freezing-thawing, which allows obtaining a product with a high content of bioactive compounds, antioxidant activity and improved physico-chemical properties and makes it possible to successfully use it in the technology of sausage products based on chicken meat and biscuits using wheat flour with a low gluten content.

The structure and content of the dissertation, the sequence, the presentation style meet the modern requirements used in scientific literature.

The conclusions of the dissertation contain a summary of the most important scientific and practical results obtained by the author during the implementation of scientific research according to the tasks defined in the dissertation.

8. Discussion clauses and remarks to the dissertation.

In general, the dissertation work was performed at a high scientific and methodical level, meets the established requirements, although it is not without some shortcomings, and some provisions are of a debatable nature.

1. The beet drying technologies taken as the basis of scientific research are quite widespread, including in Ukraine. Considering the complexity of technological equipment for microwave vacuum drying, it is not completely clear how to adapt the proposed technology to specific industrial production conditions when scaling the proposed technology.

2. In the work, the author calculated the material and energy balance when using the freeze-thaw pretreatment method. However, it is not described what the indicators of mass loss of manufactured goods were.

3. The work determines the antioxidant properties, color indicators, and drying efficiency of beets that were previously subjected to cryogenic effects (freezing-thawing). For practical use, it would also be necessary to indicate the nutritional value of dried beets, in order to understand the influence of this component in recipes on the nutritional value of industrially produced products.

4. The recipe for cookies is presented in the dissertation. However, it is not specified on the basis of which regulatory document or collection of recipes the control was chosen. It would be appropriate to indicate the source of origin of this recipe.

5. It is known that beetroot powder contains a significant amount of monosugars, but in the recipe of the developed cookies, the amount of added sugar does not change when different amounts of beetroot powder are added. It is necessary to recalculate, since this parameter significantly affects the organoleptic indicators.

6. In the recipe of meat products, dried beets are used as a food coloring, a source of nitrites and enriches their nutritional value. Since beets contain a large amount of natural nitrates, which during fermentation turn into nitrites, it would be

advisable to investigate the use of dried beets in the technology of fermented sausages.

7. The work describes the technology of meat products. However, the question of how exactly different methods of heat treatment will affect the color and appearance of the developed sausage products is not sufficiently resolved.

8. The work presents the technology and recipe of meat products with the addition of beetroot powder. However, there is no summary table of data on the quality indicators of meat products with different inclusions of beet powder in the recipe. Therefore, it is not clear how exactly the best sample was chosen.

9. There are typos in the text of the completed dissertation. The total volume of the main text of the dissertation exceeds the traditional volume of theses recommended for qualifying papers for obtaining the scientific degree of Doctor of Philosophy.

These remarks and wishes do not reduce the overall positive impression of the dissertation work.

9. General conclusion.

Dissertation work **(Liu Yan)** "Technology of semi-finished product from dried beetroot, pretreated by freeze-thaw method and food products using it", submitted for defense to the specialized academic council for obtaining the degree of Doctor of Philosophy in the field of knowledge (18) under specialty (181) according to its relevance, scientific and theoretical level, main results of validity, main provisions and results published in specialized publications, novelty of the setting and practical significance meets the requirements of the order of the Ministry of Education and Culture of Ukraine No. 40 dated January 12, 2017 "On approval of requirements for the preparation of a dissertation " and Resolution of the Cabinet of Ministers of Ukraine dated January 12, 2022 No. 44 "On approval of the Procedure for awarding the degree of Doctor of Philosophy and cancellation 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" with changes introduced in accordance with Resolution of the Cabinet of Ministers No. 341 dated 03/21/2022.

The author of the thesis, Liu Yan, deserves to be awarded the degree of Doctor of Philosophy in the field of knowledge 18 - Production and technology with the specialty 181 - Food technology.

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