Response
official opponent
Doctor of Engineering Sciences, Professor, Professor of the Department of Food Technologies, Poltava State Agrarian University
Sukmanov Valerii Oleksandrovych
for a dissertation (**Nan Haijuan**)
"Development of low-fat meat products technology using edible mushrooms",
applied for the degree of Doctor of Philosophy
from the field of knowledge 18 "Production and technologies"
in specialty 181 "Food technologies"

1. Relevance of the dissertation topic

Meat and meat products are nutritious and provide nutrition and energy to humans. However, some meat products are usually processed with up to 20-30% animal fat in order to obtain better water retention, stability and sensory properties. However, excessive intake of animal fat can lead to chronic diseases such as cardiovascular and cerebrovascular diseases. Directly reducing the fat content in meat products will inevitably lead to a decrease in the quality of meat products. Therefore, the development of low-fat meat products has received widespread attention.

Agaricus bisporus (Ab) is a mushroom rich in protein, carbohydrates and dietary fiber, yet low in fat. The dissertation involves the study of a low-fat meat product. a low-fat meat product with *Agaricus bisporus* as a fat substitute. It was shown that proteins could improve the stability of the emulsified ground meat system and polysaccharides could improve the water holding capacity of the meat product. Insoluble dietary fiber could improves the gel strength of ground meat. Theoretically, it is completely feasible to use *Agaricus bisporus* as a fat substitute to produce low-fat meat products.

Therefore, Nan Haijuan dissertation investigated the effect of *Agaricus bisporus* as a fat substitute to improve the quality, nutritional value and storage characteristics of meat products, which is highly current and relevant and has a broad development prospect.

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

The scientific inquiry for the dissertation thesis was carried out at Sumy National Agrarian University and Henan Institute of Science Technology. This work was supported by the 2021 Zhongyuan Science and Technology Innovation Leading Talent Project (No: 224200510019) and the 2022 Henan Province Key Science and Technology Research Project (No: 222102110179).

3. Scientific novelty of the obtained results.

For the first time in the dissertation, on the basis of analytical, scientific, and experimental research and trends:

— It was scientifically demonstrated that the use of *Agaricus bisporus* as a fat replacer can improve the emulsification stability, pH, and textural properties of chicken batters;

— It was investigated that a combination of *Agaricus bisporus* and soybean oil fat replacer improved the quality of chicken batters better than a combination of *Agaricus bisporus* and water fat replacer.

— Scientifically demonstrated that a fat substitute combination of Agaricus bisporus and soybean oil improved the quality of chicken batters better than a fat substitute combination of *Agaricus bisporus* and water;

— Optimized the formulation of low-fat chicken sausages containing *Agaricus bisporus*.

— A series of new data on the chemical composition, sensory indexes, nutritional value and storage characteristics of low-fat chicken sausages containing *Agaricus bisporus* were obtained, which scientifically confirmed the feasibility of *Agaricus bisporus* for the production of low-fat meat products, and were further developed and popularized;

— Systematically studied the mechanism of action of *Agaricus bisporus* in improving the quality of chicken batters;

— The process conditions for the production of low-fat chicken batters and chicken sausage using *Agaricus bisporus* as fat replacer were determined.

4. Scientific and practical significance.

On the basis of fundamental and applied research, low-fat chicken batters containing *Agaricus bisporus* was developed and further applied as semi-finished products in the process of chicken sausage, which not only improved the nutritional value of sausage, but also positively affected the storage characteristics and sensory properties of sausage.

The research results of the thesis can be used in the teaching process of “Technology of Nutrition”, “Food Quality and Safety”, “Functional Foods”, “Technology of Meat Products”, “General Technology of Food Products” and other disciplines. At the same time, the research results can be used in fundamental and applied research in the direction of food technology.

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

The main findings of the dissertation work are presented in 9 printed works, including: 1 monograph, 5 articles in journals listed in the international scientometric databases Scopus and Web of Science Core Collection, and 3 articles in Ukrainian scientific specialized journals.

The publications sufficiently represent and support the study that was done.

6. The degree of validity of scientific statements.

The main scientific propositions and conclusions put forward in this paper are logically demonstrated and developed on the basis of multilateral research.

The research mission was developed based on an in-depth analysis and research of more than 207 literature sources. To achieve the objectives of the research, the authors propose a step-by-step plan to conduct a high scientific level thesis research experiment.

In addition to mathematical statistical processing of experimental results, the research also adopted physical chemistry, microbiology, biochemistry, spectroscopy, physical mechanics, sensory and comprehensive techniques.

The comprehensive solution of the task, the comprehensive experimentation and analysis of the results obtained, the industrial endorsement of the proposed technical solutions, and the extensive discussion of the findings in scientific conferences and publications allow us to draw conclusions about the high validity of the scientific statements and the reliability of the 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 thesis is 164 pages lengthy, including 37 tables, 41 pictures, and appendices.

In the dissertation work, the laws of planning and conducting scientific research are followed, as are modern research methodologies and methods of processing experiment results. The work's scientific distinctiveness is based on comprehensive research that applies generally accepted research procedures at a sufficient level.

The text of the dissertation is written in English and and Ukrainian in a logical and consistent manner. Dissertation structure, language and presentation style meet the requirements for PhD dissertations.

8. Discussion clauses and remarks to the dissertation.

Along with the positive evaluation of the dissertation work, it can be noted that some statements are disputed or need to be revised:

1. The dissertation only investigated *Agaricus bisporus* as a fat replacer, it would be more meaningful to investigate the feasibility of other edible mushrooms as fat replacers;

2. Only the use of *Agaricus bisporus* in chicken products was studied in the paper. It would be more meaningful to study the possibility of using *Agaricus bisporus* in low-fat pork products.

3. Information with some statistical confidence is given in the paper. However, the work lacks optimal modeling of the effect of *Agaricus bisporus* addition on parameters of sausage products.

4. Only the effect of *Agaricus bisporus* and soybean oil as a complex fat substitute on sausage was studied in the dissertation, it would be more meaningful to study the effect of compounding *Agaricus bisporus* with other vegetable oils;

5. The storage of the sausage samples, the storage conditions and the details of the packaging materials were not particularly clear.

6. There are some typographical and punctuation errors in the dissertation,

but this does not affect the understanding of the text.

However, the remarks given above do not influence on general positive impression and completeness of information mentioned in Haijuan Nan's dissertation.

9. General conclusion.

Dissertation work (**Nan Haijuan**) "Development of low-fat meat products technology using edible mushrooms", which was submitted for defence to the specialized academic council for obtaining the degree of Doctor of Philosophy in the field of knowledge (18) in the specialty (181) according to its relevance, scientific and theoretical level, main results of validity, main provisions and results published in professional publications, novelty statement and practical meaning meets the requirements of the Order of the Ministry of Education and Science of Ukraine No. 40 of January 12, 2017 "On approval of requirements for the preparation of a dissertation" and Resolution of the Cabinet of Ministers of Ukraine of January 12, 2022 No. 44 "On approval of the Procedure for awarding 8 the degree of Doctor of Philosophy and cancellation of the decision of a one-time specialized of the 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 CM No. 341 dated 03/21/2022.

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