Response
official opponent

Candidate of Agricultural Sciences, Associate Professor,
Associate Professor of the Department of Food Technologies and
Hotel and Restaurant Business
Dmytro Motornyi Tavria State Agrotechnological University
Bandura Iryna Ivanivna

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) by specialty (181)

1. Relevance of the dissertation topic

Meat and meat products are rich in nutrients and can provide essential elements to the human body. However, some meat products are often made with up to 20-30% animal fat to obtain better water retention, stability, and organoleptic properties. Numerous studies have indicated that dietary fat intake is connected to certain chronic diseases. The quality of meat products can be decreased by directly reducing their fat content. One of the hot spots in meat product research is the development of low-fat meat products.

Nan Haijuan's thesis is concerned with the use of edible mushrooms as fat substitutes to obtain low-fat meat products. She chose *Agaricus bisporus* (J.E. Lange) Imbach (Ab) is a mushroom species cultivated worldwide that is low in fat and rich in protein, carbohydrates, and dietary fiber. Studies have shown that protein improves the stability of emulsified meat systems and polysaccharides improve the water retention of meat products. Insoluble dietary fiber can improve the gel strength of ground meat. Theoretically, *Agaricus bisporus* can be used as a fat substitute in meat processing.

Therefore, Haijuan Nan's dissertation work, which focused on meat products using *A. bisporus* flour to provide utility, reduce fat content, raise nutritional value, and improve quality attributes, is timely, relevant, and shows promise for further development.

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

Sumy National Agrarian University and Henan Institute of Science Technology were followed in the scientific investigation of the dissertation thesis. 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) provided funding for this work.

3. Scientific novelty of the obtained results.

Every element of the thesis is infused with the study's inherent scientific uniqueness. The obtained results' scientific novelty comes from the fact that: by means of both theoretical and experimental research, the viability of using *A. bisporus* flour for the production of low-fat chicken batters has been proved; the

process of making low-fat chicken sausage from low-fat chicken batters containing *A. bisporus* flour has been studied and scientifically verified.

For the first time, in the thesis:

-Application of *A. bisporus* flour as a fat substitute in the production of low-fat chicken batters and low-fat chicken sausages.

-Compounding of *A. bisporus* flour and soybean oil to produce of low-fat meat products.

–A systematic study of the mechanism of action of *A. bisporus* flour to improve the quality of chicken batters.

-The process technology of the production of low-fat chicken batters and chicken sausage with *A. bisporus* flour were determined.

4. Scientific and practical significance.

The identification of the most effective process parameters for using *A. bisporus* flour as a fat substitute in the creation of low-fat chicken batters and the enhancement of the production process method for its use in low-fat chicken sausage are included in the practical portion of this thesis.

An *A. bisporus* flour-containing low-fat chicken sausage manufacturing method was created using the findings of theoretical and experimental research. Both Henan Fengxiang Fengwei Food Co. LTD and Henan Jiaduoduo Food Co. LTD have adopted the enhanced low-fat chicken sausage production process.

The dissertation findings can be applied to the educational process when studying the subjects "Fundamentals of physiology and food hygiene", "Nutritionology", "Quality and safety of food products", and "General technologies of food production". At the same time, study findings can be applied to fundamental and applied research in the field of food technologies.

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

The main findings of the dissertation work are presented in one monograph, 8 articles in scientific journals, 5 articles in journals listed in the international scientometric databases Scopus and Web of Science Core Collection, and three articles in Ukrainian scientific specialized journals.

The list of publications about the dissertation thesis conforms with the requirements of clause 11 of the "Temporary order awarding the degree of Doctor of Philosophy", which was approved by Resolution of the Cabinet of Ministers of Ukraine No. 167 on March 6, 2019.

List of the applicant's publications

1. Haijaun Nan, Kondratiuk Natalia, Stepanova Tetiana, Afanasiiev Oleksander, Sytnyk Kateryna, Suprunenko Kateryna. Vegetable protein blend technology for vegetarian sausages. Науковий вісник Полтавського університету економіки і торгівлі, 2019, 1(91), 38-46. doi.org/10.37734/2518-7171-2019-1-5.

2. Haijaun Nan, Kondratiuk Natalia, Stepanova Tetiana, Suprunenko Kateryna Prospects of cultivated mushrooms use of technology of sausages.

Bulletin of the National Technical University «KhPI» Series: New solutions in modern technologies, 2019, 2, 75-80. doi.org/10.20998/2413-4295.2019.02.11.

3. Haijuan Nan, Bo Li, Stepanova Tetiana. Relevance of cultivated mushrooms usage in food and perspectives in sausage processing. Academic notes of V.I. Vernadskyi TNU. Series: Technical sciences, 2021, 32(71), 142-147. https://doi.org/10.32838/2663-5941/2021.2-2/22.

4. Haijuan Nan, Stepanova Tetiana, Bo Li, Kondratiuk Natalia. Effect of Agaricus bisporus on gel properties and microstructure of chicken batters. Journal of Hygienic Engineering and Design, 2021, (9): 170-178. Стаття у міжнародній наукометричній базі Scopus Q4.

5. Haijuan Nan, Bo Li, Kondratiuk Natalia, Sylchuk Tetiana, Stepanova Tetiana. Effect of different particle sizes of Agaricus bisporus and soybean oil on rheological properties, moisture distribution and microstructure of chicken batters. Journal of Chemistry and Technologies, 2021, 29(2), 342-352. doi.org/10.15421/jchemtech.v29i2.228820.

6. Haijuan Nan, Stepanova Tetiana, Kondratiuk Natalia, Yuanyang Nie, Bo Li. Effects of Agaricus bisporus on gel properties of chicken myofibrillar protein. International Journal of Food Science and Technology, 2022, 7. doi.org/10.1111/ijfs.15898.

7. Haijuan Nan, Haoyu Zhou, Bo Li, Stepanova Tetiana, Kondratiuk Natalia. Effects of Agaricus bisporus alone or in combination with soybean oil or water as fat substitutes on gel properties, rheology, water distribution, and microstructure of chicken batters. Food Science and Technology, 2022, 42, e116121. doi.org/10.1590/fst.116121.

8. Haijuan Nan, Stepanova Tetiana, Bo Li. Effects of button mushroom Agaricus bisporus (Agaricomycetes) and soybean oil on storage characteristics of chicken sausage. International Journal of Medicinal Mushrooms, 2023, 7. doi.org/10.1615/IntJMedMushrooms.2023049470.

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

6. The degree of validity of scientific statements.

The primary scientific claims and findings of the thesis were supported by multilateral investigation and rationally developed.

The research work was created using both original research and a thorough examination of over 207 literature sources. The authors suggested a step-by-step approach for carrying out the dissertation research experiments at a high scientific level to meet the aims of the dissertation.

Numerous analytical, physicochemical, microbiological, biochemical, spectroscopic, physical-mechanical, sensory, systematic, integrative, and mathematical modelling techniques were employed in the research, in addition to mathematical-statistical processing of the experimental results.

We were able to reach the following conclusions regarding the high validity of the scientific statements and the reliability of the research results: thorough task solution; modern, thorough experimentation and analysis of the obtained results;

industry recognition of the proposed technical solutions; and extensive discussion of the research results at scientific conferences and publications.

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

An abstract, an introduction, five chapters, conclusions, a list of used literary sources, and appendices comprise the dissertation. The main text of the thesis is 161 pages long, with 37 tables, 41 illustrations, and appendices.

The laws of planning and performing scientific research are followed in the dissertation work, as are modern research methodologies and ways of processing experiment results. The scientific uniqueness of the work's results is based on extensive research that employs generally acknowledged research methodologies at an adequate level.

The text of the dissertation by Haijuan Nan is written by competent technical English 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, certain claims are disputed or need to be revised:

1. The content of the ANNOTATION is a little too much, it is recommended to shorten the content of it.

2. Chicken is used as the main meat raw material for making research. It would be interesting to investigate the possibility of using *A. bisporus* flour on meat product from pork.

3. Materials with certain statistical reliability are given in the work. But the work lacks optimization modelling of the process of *A. bisporus* flour influence on the parameters of sausage products.

4. For storing trial samples of sausages, the storage conditions and detailed information of packaging materials are not particularly clearly stated.

5. There are some typing errors and punctuation mistakes in the thesis, an incorrect transfer of tables from page to page but this does not affect the understanding of the text of the thesis.

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.

Official opponent,

Candidate of Agricultural Sciences,
Associate Professor, Associate Professor of the Department
of Food Technologies and Hotel and Restaurant Business
Dmytro Motornyi Tavria State
Agrotechnological University **Iryna BANDURA**

The signature of Bandura I.I.
Has been certified by
Head of the Personnel Department
of TSATU **Kateryna HANCHUK**