MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

SUMY NATIONAL AGRARIAN UNIVERSITY

METHODOLOGICAL INSTRUCTIONS FOR IMPLEMENTATION QUALIFICATION WORK

Sumy 2024

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

SUMY NATIONAL AGRARIAN UNIVERSITY

FACULTY OF FOOD TECHNOLOGY

METHODOLOGICAL INSTRUCTIONS FOR IMPLEMENTATION QUALIFICATION WORK

field of knowledge: 18 "Production and Technology"
specialty: 181 "Food Technology"
educational and qualification level

"MASTER"

Sumy 2024

UDC 641.5

M-54

Compilers:

Melnyk O.Yu., Ph.D., Associate Professor, Head of the Department of Food Technology,

Pertsevoy F.V., Doctor of Technical Sciences, Professor, Department of Food Technology,

Samilyk M.M., Ph.D., Head of the Department of Food Technology and Safety,

Helikh A.O., Ph.D., Associate Professor of the Department of Food Technology and Safety,

Turchina S.G., Candidate of Economic Sciences, Associate Professor of the Department of Management.

M - 54 **Methodical instructions for performing qualification work** for students of the 2nd year of the SVO "Master" specialty 181 " Food technologies " / compiled by O.Yu. Melnyk, F.V. Pertsevoy, M.M. Samilyk, A.O. Helikh, S.G. Turchina - Sumy, 2024. - 82 p.

Methodological instructions for performing qualification work are aimed at providing students with methodological assistance during the performance of qualification work to help the student acquire skills logically and reasonedly present the material, correctly use analytical and statistical methods of scientific research, conduct experiments, formulate conclusions, develop and implement scientific and technical projects, organize a system of quality control and safety of food raw materials and finished products, predict the further development of the food industry, solve professional tasks at enterprises of the industry and restaurant establishments.

Reviewers:

Omelchenko S.B., Ph.D., Associate Professor of the Department of Food Technologies in the Restaurant Industry, SBU,

Mazurenko I.K., Doctor of Technical Sciences, Professor of the Department of Food Technology, SNAU.

Responsible for the release: guarantor of the educational program, professor of the Department of Food Technology of SNAU, Doctor of Technical Sciences Pertsevoy F.V.

Recommended for publication by the Educational and Methodological Council of the Faculty of Food Technology of the SNAU. Protocol No. 4 dated March 26, 2024.

CONTENT

INTRODUCTION

The Regulation on Qualification Work is a component of the system of internal quality assurance of educational activities and the quality of higher education at Sumy National Agrarian University (hereinafter referred to as SNAU), regulates the organization of preparation and defense of the final qualification work and was developed taking into account the requirements of the Law of Ukraine "On Higher Education", instructions of the Ministry of Education and Science of Ukraine, the standard of higher education of Ukraine in specialty 181 "Food Technologies", "Regulations on the Examination Commission for Certification of Higher Education Applicants at SNAU", as well as the experience acquired by SNAU in the implementation of final qualification projects (works) by students.

Qualification work is qualifying independent research carried out by a student at the final stage of study at SNAU. Qualification work is intended for an objective assessment of the degree of formation of knowledge and skills to solve professional tasks specified in the characteristics of the relevant educational and professional master's program, an integral part of which is scientific research.

Based on the defense of the qualification work, the Examination Commission (EC) decides on the issue of awarding the student the appropriate qualification and issuing a master's degree. In addition, during the defense of the qualification work, master's students demonstrate their skills in communicating with the audience, the ability to formulate and express opinions, and correctly and confidently answer questions from those present.

Qualification work must have a practical reflection and internal unity and fully correspond to the set goal of the chosen topic. On the one hand, qualification work has a generalizing nature, since it is a kind of summary of the master's training; but on the other hand, it is an independent original scientific and practical research of the student.

Therefore, the completion of qualification work, as the final stage of training specialists in a higher educational institution, aims to form in the student general and professional competencies provided for by the educational program for master's training.

As a result of writing the qualification paper, the student ***will be able to demonstrate:***

- the ability to act socially aware, to show initiative and resourcefulness;
- the ability to find and analyze the necessary information in scientific and technical literature, electronic databases, and choose innovative research directions taking into account economics and marketing;
- the ability to use special equipment, methods and techniques both during scientific research and in production;

- to choose the most promising and rational directions of scientific and technical activity, the ability to conduct research, analyze the results obtained and draw conclusions, reproduce the results of scientific research and testing in the production conditions of actually operating enterprises;

- the ability to develop new food products, culinary products and improve existing ones, conduct scientific research and optimize technological processes;

- the ability to organize production and implement scientific and technical projects taking into account current directions of development of the food industry;

- the ability to organize a system of quality control and safety of food raw materials, semi-finished products and food products;

- the ability to communicate and present the results to the audience and discuss them, prepare scientific publications, and security documents.

Qualification work must meet ***the requirements:***

– the focus of all developments on revealing topics and tasks relevant to the agro-industrial complex and the processing industry;

– compliance with real production conditions;

– clarity of structure and logical presentation of the material;

– brevity and persuasiveness of arguments and conclusions;

– validity and generalization of theoretical and practical recommendations for production.

Specific tasks of the qualification work depend on its orientation (practical, scientific - research) and the object of research. The task may be the search and justification of new technologies, improvement of existing processes, creation and use of new samples of food products, in-depth study of theoretical models, mastering the methodology, techniques and modern tools of scientific research.

Qualification work should be carried out taking into account modern theoretical and practical domestic and foreign experience. Research carried out by a master can be a continuation of the student's scientific and practical work begun in previous courses and find its further development in the performance of a candidate's thesis, and can also be implemented at operating enterprises.

The qualification work is drawn up in the state language as a manuscript of 50…70 pages of typewritten text in A4 format with the results of experimental research presented in the form of figures and tables, depending on the topic of the research. It should not contain theoretical provisions, methods, etc. copied from textbooks or manuals, but only references to them are allowed. Responsibility for the reliability of the initial, calculated and adopted data in the master's thesis lies with the student - the author of the work. The supervisor helps the student to justify, determine and make the right decision, check and evaluate the decisions made.

A recommended component of the master's thesis is the preparation of a

publication of an article and theses based on the results of scientific research.

The supervisor of the final qualification work is appointed by a lecturer of the department who has a doctorate or candidate of sciences degree, an academic title and conducts scientific research in the relevant field.

1. ORGANIZATIONAL MEASURES FOR THE IMPLEMENTATION of QUALIFICATION WORK

1.1. Subject of the qualification works

The first stage in writing a qualification paper is choosing a research topic. The topic should be relevant, practically significant, have a research character, and reflect important issues in food technology. Choosing and formulating a topic correctly means:

− unmistakably determine its relevance and appropriateness, novelty and prospects;

− take into account the availability of a theoretical basis, the possibility of conducting experimental research, and the possibility of obtaining significant socio-economic results.

To do this, you need to conduct an independent search for information by familiarizing yourself with information sources (about 45…100 literary sources):

− articles in professional journals, collections of scientific works, periodicals,

− dissertation abstracts,

− textbooks and study guides,

− monographs,

− patents,

− Internet resources, in particular information from professional technological forums, exhibitions, information from domestic and foreign research institutes, restaurant and food industry enterprises, etc.

Choosing a topic for a qualification thesis, like any research paper, includes several general approaches, including:

− studying the topics of the graduate department's scientific plans and programs;

− familiarization with catalogs of previously defended diploma theses, dissertations, monographs, articles on the chosen topic;

− Evaluation of known scientific and production solutions using classical and new research methods or from the standpoint of traditional or new theoretical knowledge.

Topics of qualification papers in specialty 181 "Food Technologies" are

selected from the recommended list or independently in agreement with the scientific supervisor.

The student is given the right to independently choose the topic of the qualification work in accordance with the topic approved by the graduating department. In addition, qualification works can be carried out on the topic ordered by state institutions, enterprises and business structures. The student, in agreement with the supervisor, can propose his research topic under the conditions of appropriate justification of the feasibility of its development (in accordance with his previous scientific research work, place of work, opportunities to obtain the necessary information at the research site).

As a rule, the topics are related to: improvement or development of new technologies of food products (dishes) due to modifications of the recipe composition and the use of various technological methods of influencing the process; research of organoleptic, physicochemical, structural-mechanical, technological properties of the dish; study of the nutritional and biological value of the developed product, etc.

The topic of the qualification work should provide for the solution of economic, organizational and social issues related to a certain area of research, take into account the real possibility of obtaining technologically new products. The solution of the tasks can be achieved by creating fundamentally new technologies, improving traditional technologies, identifying objective trends in the development of biological, chemical and mechanical processes that occur during the manufacture of specific products.

It is desirable that the work be carried out on the basis of (or to order) an interested enterprise or organization, thanks to which its results acquire practical significance.

After studying the sources, the student draws up a plan that is agreed upon with the academic supervisor, the head of the educational and professional program, the consultant, the head of the graduate department, and the dean.

The detailed plan is specified in the assignment for the final qualification work (hereinafter referred to as the Assignment - an example is provided in Appendix B), which, with the approval of the scientific supervisor, may be adjusted. Appropriate notes are made about this in the approved version.

An example of the design of the title page of a qualification thesis is given in Appendix B.

After selecting the topic of the qualification work, the scientific supervisor together with the student develops a detailed individual work plan for its practical implementation. The specified plan regulates the sequence and timing of work on individual stages of writing the qualification work and includes a working curriculum with professional practice, as well as a plan that fixes the sequence of implementation and content of sections and subsections of the qualification work.

The topic of qualification works and the deadlines for their completion are determined at the beginning of the academic year in the master's program. The student independently chooses the topic of the work, with the obligatory definition of the subject of research and its relevance, formulates it in the application (Appendix A). The selected topic is approved by the head of the department, who appoints a scientific supervisor to the master's student. An indicative list of topics for master's works is presented in Appendix C.

1.2. Main stages of performing qualification work

1. Choosing a topic and object of research.
2. Receiving an assignment for qualification work, drawing up a calendar plan for its implementation.
3. Studying educational and scientific literature, choosing a problem and drawing up a detailed work plan.
4. Preparation for research: drawing up a research program and plan, selecting research methods, mastering research techniques.
5. Conducting research.
6. Processing of factual material using a PC.
7. Writing the first version of the text, submitting it to the manager for review.
8. Elimination of shortcomings, writing the final version of the text, preparation of the qualification work.
9. Submitting the work to the manager for review, receiving feedback.
10. Preliminary defense of the qualification work at the department.
11. Plagiarism check.
12. External review of the work.
13. Defense of the qualification work at a meeting of the examination committee (EC).

For the period of the qualification work, the department draws up a schedule of consultations with the scientific supervisor, according to which systematic cooperation between the student and the supervisor on the qualification work is ensured. Systematic consultations help the student in choosing research methods, in monitoring compliance with the requirements for the content and design of the work, in timely eliminating deviations. Prompt and careful implementation of the supervisor's recommendations contributes to the timely submission of the qualification work for verification and is the key to its successful defense.

Violation by a student of the calendar plan for completing the qualification work is recorded by the supervisor, who informs the head of the department.

1.3. Organization of qualification work

The deadline for completing the qualification work is determined by the schedule of the educational process.

The qualification work must be performed by the student in full accordance with the approved calendar plan and tasks. In cases of lagging behind the schedule, the student is obliged to give an explanation to his/her supervisor or head of the department.

In the event of a positive review by the scientific supervisor, the work is registered at the department and submitted for consideration to the head of the department, who must make a decision on the student's admission to the defense of the work at the EC meeting.

After the student submits the work for plagiarism check to the department of quality assurance of higher education. After all the necessary preliminary procedures at the department, receiving positive results of the check, the qualification work is submitted for review. The list of reviewers is compiled at the department and approved by the dean of the faculty in accordance with the established procedure.

In addition, before submitting the qualification work for defense, it is submitted for plagiarism checking to the Higher Education Quality Assurance Department.

1.4. Scientific supervisor of the qualification work

Scientific supervisors of qualification work may be teachers with scientific degrees and academic titles who conduct scientific research that meets the specifics and content of the educational program.

The scientific supervisor of the qualification work is appointed at a meeting of the department where the educational program is implemented, in accordance with the academic load, scientific interests of the NPP, taking into account the wishes of applicants who have the right to choose a scientific supervisor. The list of potential scientific supervisors of the qualification work is agreed with the guarantor of the educational program.

Scientific supervisor of the qualification work:

provides scientific guidance for the preparation of the work;

formulates tasks for its implementation together with the applicant;

approves the qualification work plan and, if necessary, its adjustments,

and also agrees on the object and subject of the research;

recommends necessary basic literature, reference and other materials;

monitors the student's adherence to the calendar schedule for completing the qualification work;

informs at the department meeting about the progress of the student's

calendar schedule;

analyzes and professionally reviews the structural parts of the qualification work;

systematically advises applicants (in person, according to the approved consultation schedule, or via electronic means of communication) regarding the content and procedure for writing the qualification paper, adherence to the principles of academic integrity and research ethics;

If necessary, together with the student, makes suggestions regarding the adjustment of the topic of the qualification work.

Changes in the wording of the title of the work based on the student's application provide for amendments to the order upon written submission by the head of the department (extract from the minutes of the department meeting) no later than two months before the defense;

provides written feedback on the completed qualification work;

participates in the preliminary defense and public defense of the qualification work.

Changes in the heads of qualification works are issued by order of the university upon written request of the head of the department where the educational program is implemented, in the event of such a need.

1.5. Rights and obligations of the applicant

A higher education student has the right to:

- choose a topic for a qualification study from the list of topics offered by the department or propose your own with the necessary justification for its development (taking into account the areas of scientific interests of the department's teaching staff);

-receive advisory assistance from the manager regarding the qualification study;

-to familiarize yourself with the conclusion of the scientific supervisor and the review of the completed qualification study.

A higher education student is obliged to:

- attend general consultations, briefings on writing a qualification study;

- adhere to the calendar plan for performing the qualification work;

- complete and formalize qualification work in accordance with the requirements established by the higher education institution;

- comply with current legislation regarding the preservation of copyright;

- be responsible for the quality of the prepared qualification work, the reliability of the data obtained;

- timely submit sections of the qualification research to the scientific supervisor for processing (according to the schedule);

- take into account the recommendations of the scientific supervisor and adhere to the norms of academic integrity;

- send the completed qualification study to the department's email box to check it for borrowings;

- according to the calendar schedule, submit a completed qualification work to the department, prepare a report and presentation for defense;

- go through the procedure of preliminary defense and defense of the qualifying research.

1.6. The role of the guarantor of the educational program

The guarantor of the educational program ensures the formation of a list of recommended topics for qualification works, its annual adjustment in accordance with modern challenges and development trends in the relevant field, the requirements of national and regional markets, the characteristics of the labor market, and the proposals of stakeholders.

The guarantor of the educational program ensures the organization of the procedure for applicants to choose the topic of their qualification work and scientific supervisors, agrees on the topics of the works proposed by the applicants independently, and submits the issue of approving the topics of their qualification work and scientific supervisors to the department meeting.

The guarantor may provide advice to academic supervisors and applicants regarding the compliance of the structure, object and subject of research, and the content of the qualification work with the educational program.

The guarantor of the educational program heads the relevant commissions for the preliminary defense of the qualification work and makes a decision on the admission (conditional admission, non-admission) of the qualification work to public defense at a meeting of the certification commission.

The guarantor of the educational program is, as a rule, a member of the relevant certification commission, at the meeting of which the qualification work is defended.

1.7. Research ethics

Ethical research practice requires that higher education students act openly and honestly at all stages of the research process, making every effort to ensure the reliability of their conclusions. Thus, the starting points for qualifying work are openness, honesty, thoroughness and accuracy in conducting research, as well as in recording, presenting and evaluating its results. The methods used for data collection, as well as for research and evaluation of results, should meet scientific criteria and be ethically sound.

The very formulation of the topic of the qualification study cannot be

morally questionable.

Higher education students must adhere to scientific standards when planning and conducting qualifying research, reporting its results, and recording data obtained during the research.

If the qualification work aims to obtain data through surveys, questionnaires, or interviews, the ethical implications of the research must be discussed with the scientific supervisor.

The university has a responsibility to protect the privacy, health, cultural sensitivity and well-being of individuals, so supervisors and students should be aware of the ethical issues of research. Violation of research ethics will reduce the credibility of the results of the qualification work, as the data obtained should not be morally questionable.

During the preparation of the qualification work, all participants in the educational process (student, scientific supervisor) must adhere to the fundamental principles of research ethics and academic integrity (Appendix I).

2. CONTENT AND SCOPE of QUALIFICATION WORK

2.1. Structure of the qualification work

The qualification work should be 50-70 pages of text.

The content of the qualification work is determined by its topic and is reflected in the plan developed with the help of the scientific supervisor. In accordance with the chosen topic, the student independently or on the recommendation of the supervisor selects literary sources and relevant regulatory documents and draws up a draft plan, which he discusses with the supervisor.

The task for the qualification work (Appendix B) generally determines the content of the work and contains the following sections in the main part:

- title of the work topic;
- a summary of the text and graphic parts of the work (software);
- initial data for research design.

At the same time, a work schedule is drawn up (Appendix B).

Regardless of the specialty profile, the explanatory note to the qualification work must contain the following mandatory structural elements:

- title page with the signatures of the student, supervisor, reviewer and be approved by the head of the graduating department;
- assignment for the qualification work, approved by the head of the graduation department and signed by the student, supervisor, and consultants from individual sections of the work;
- an abstract in the state language and one of the languages of international communication (a concise summary of the work with a total volume of no more than 150 words);
- list of abbreviations (if necessary) in alphabetical order;

- introduction (relevance, goal, objectives, object and subject of the research, research methods, scientific novelty of the results obtained and their practical significance, publications (if any) and the student's personal contribution, if published scientific works (or positive decisions and patents for inventions obtained) on the topic of the work are co-authored;

- literature review;

-feasibility study and scientific and technical justification (if necessary) and selection of optimal options for mathematical models of the object and subject and research methods, etc.;

- sections of the main part, the content and list of which are determined by the profile of the specialty and the topic of the qualification work, and the requirements for them are specified by the graduating department in the methodological instructions for performing the qualification work in the relevant specialty;

- a section of the economic part, which should contain a calculation of the efficiency of development, calculations of costs for conducting exploratory design work, manufacturing prototypes, etc.;

- conclusions, which formulate the main conclusions of the work, the results obtained, prospects and directions for further research, etc.;

- a list of used literature, in which the names of used literary sources, patents, regulatory and technical documents, addresses of Internet sites, etc. are placed in the order of appearance of references in the text of the software or in alphabetical order;

- appendices (tables, various diagrams, etc.).

The graphic part of the qualification work contains all the mandatory materials specified in the assignment, as well as additional illustrative materials (slides, posters) made to facilitate the defense (the quantity is not regulated, but they do not replace the mandatory diagrams and other illustrations).

The graphic part of the qualification work is drawn up in accordance with the requirements of current standards.

2.2. Requirements for the preparation of the qualification work

The work must be formatted in accordance with the State Standard of Ukraine DSTU 3008-95 “Documentation. Reports in the field of science and technology. Structure and rules of formatting” and “Methodological instructions for formatting course and qualification papers” [72]. Given the high requirements of regulatory documents, it is necessary to strictly adhere to the procedure for submitting certain types of text material, tables, formulas and illustrations.

The qualification work is printed on one side of a sheet of white A4 paper, font – TimesNewRoman (other fonts may be used to highlight examples,

concepts, etc.), font size – 14, line spacing 1.5 intervals (up to 30 lines per page), top and bottom margins – 20 mm, left – 30 mm, right – 10 mm.

The font of the print must be clear. The density of the text must be the same. It is allowed to enter individual foreign words, formulas, and symbols in it only in black ink.

Each formula is written on a new line, symmetrically to the text. One line is skipped between the formula and the text. The conventional letter designations (symbols) in the formula are given in the text or immediately below the formula. To do this, a comma is placed after the formula and an explanation of each symbol is written on a new line in the sequence in which they are given in the formula, separated by a semicolon. The first line must begin with a paragraph with the word "where" and without any sign after it. All formulas are numbered within the section with Arabic numerals. The number is indicated in parentheses on the right side, at the end of the line, at the end of the formula. The formula number consists of the section number and the ordinal number of the formula in the section, separated by a period. It is allowed to perform numbering within the entire document.

The text of the main part of the work is divided into sections, subsections, paragraphs, and sub-sections. The headings of the structural parts of the work: TABLE OF CONTENTS, INTRODUCTION, CHAPTER, CONCLUSIONS, LIST OF REFERENCES, APPENDICES are printed in capital letters symmetrically to the text in bold.

The headings of the structural part (sections) are also printed in capital letters symmetrically to the text in bold. The headings of the subsections are printed in small letters (except for the first capital letter) from the paragraph in bold. A period is not placed at the end of the heading. The headings of the paragraphs are printed in small letters (except for the first capital letter) from the paragraph. A period is placed at the end of the heading. The distance between the heading (except for the heading of the paragraph) and the text should be equal to 3–4 intervals (2 indents).

Each structural part of the qualification work should begin on a new page.

The total volume of the qualification work does not include appendices, a list of sources used, tables and figures that completely occupy the page area. At the same time, all pages of the specified elements of the work must be numbered.

Illustrative material for the defense of the qualification work can be made in the form of posters, drawings and presented using overhead projectors and computer tools. The content of the illustrative material must sufficiently fully reflect the main provisions that are put forward for defense.

All pages of the qualification work are subject to numbering on a general basis.

The numbering of pages, sections, subsections, paragraphs, sub-

paragraphs, figures, tables, and formulas is given in Arabic numerals without the number sign.

The page number is not placed on the title page; on subsequent pages, the number is placed in the upper right corner of the page without a period at the end.

The section number is placed after the word "SECTION", no period is placed after the number, then the section title is printed on a new line.

Subsections are numbered within each section. The subsection number consists of the section number and the ordinal number of the subsection, between which a period is placed. The period is not placed at the end of the subsection number, for example: "2.3" (the third subsection of the second section). Then the subsection title is placed on the same line.

Paragraphs are numbered within each subsection. The paragraph number consists of the serial numbers of the section, subsection, and paragraph, between which a period is placed. A period is not placed at the end of the number, for example: “1.3.2” (the second paragraph of the third subsection of the first section). Then, on the same line, the paragraph heading is followed. The paragraph may not have a heading. If there is no heading, a period is placed at the end of the number.

Sub-paragraphs are numbered within each paragraph according to the same rules as paragraphs.

Illustrations (photographs, drawings, diagrams, graphs, maps) and tables should be presented directly after the text, where they are first mentioned, or on the next page.

Illustrations are designated by the word "Fig." and numbered consecutively within the section, with the exception of illustrations presented in the appendices. If there is only one figure in the work, it is numbered according to general rules.

The illustration number should consist of the section number and the illustration serial number, with a period between them. The illustration number, its title, and explanatory captions are placed sequentially below the illustration.

Tables are numbered sequentially (except for tables given in the appendices) within the section. In the upper left corner before the corresponding table title, the inscription “Table” is placed, indicating its number. The table number should consist of the section number and the ordinal number of the table, between which a period is placed, and after the table number a dash, for example: “Table 1.2 –”. If there is one table in the work, it is numbered according to general rules.

When transferring part of a table to another page, the word "Table" and its number are indicated once on the left above the first part of the table, and above the other parts, the words "Continuation of table" are written and the table number is indicated, for example, "Continuation of table 1.2."

Formulas are numbered within the section. The formula number consists of

the section number and the ordinal number of the formula in the section, between which a period is placed. Formula numbers are written near the right margin of the sheet at the level of the corresponding formula in parentheses, for example: (3.1) (the first formula of the third section).

2.3. Requirements for the design of the main structural elements of the qualification work

Title page

The first page of the work is designed in accordance with the requirements of state standards for library and publishing. The title page (Appendix B) must contain the following details:

− name of the educational institution;
− name of the faculty and department;
− topic of the qualification work;
− Last name, first name, patronymic of the author;
− course and its group number;
− Last name, initials, academic degree and title of the scientific supervisor;
− Place and year of completion of the qualification work.

Task

The assignment for the qualification work contains: the topic of the qualification work, deadlines, initial data for the work and the content of the explanatory note. An example of the assignment is given in the appendices (Appendix B).

Annotation

The abstract, which is approximately 800 characters long, includes the applicant's last name and initials, the title of the qualification work, the main content and results of the research, and keywords (words of specific terminology on the topic that are most often found in the qualification work) in the nominative case. The number of keywords is 5-7.

The abstract must be written in Ukrainian, Russian and one of the foreign languages (most often English).

FROM cities

The table of contents (actually the individual work plan) is submitted at the beginning of the qualification work. It contains the names and numbers of the initial pages of all sections, subsections and paragraphs, in particular the introduction, conclusions to the sections, general conclusions, appendices, list of used literature, etc. That is, it is a list of sequentially compiled activities that reveal

the content of the topic; it should be made detailed and detailed. The work plan consists of sections, the names and sequence of which should reflect the structure of the research topic; move from general questions to more specific ones. In this way, the structure of each subsequent section is formed. In the process of performing the qualification work, the content can be adjusted (with the approval of the scientific supervisor).

LIST of abbreviations and symbols

If the paper uses specific terminology, as well as little-known abbreviations, new symbols, notations, and so on, their list can be presented in the paper as a separate list, which is placed before the introduction. The list should be printed in two columns, in which, for example, abbreviations are listed alphabetically on the left, and a detailed explanation is given on the right.

If special terms, abbreviations, symbols, designations, and so on are repeated less than three times in the work, a list is not compiled, and their interpretation is given in the text at the first mention.

Introduction

The introduction is 4...6 pages long and reflects the relevance and appropriateness of the chosen topic.

The introduction reveals the essence and state of the scientific or scientific-practical problem (task) and its significance, the grounds and initial data for developing the topic, and the justification for the need to conduct research.

Next, a general description of the thesis is presented in the sequence recommended below.

Relevance of the topic. Through critical analysis and comparison with known solutions to the problem (scientific task), the relevance and feasibility of the work for the development of the field of knowledge 18 "Production and Technology", especially for the benefit of Ukraine, are substantiated. The coverage of relevance should be concise and emphasize the essence of the problem.

The connection of the work with scientific programs, plans, topics. Briefly outline the connection of the selected research direction with the plans of the organization where the work was performed, as well as with industry and (or) state plans and programs.

The purpose and objectives of the study. Formulate the purpose of the work and the tasks that need to be solved to achieve the set goal. The purpose should not be formulated as "Research...", "Study...", because these words indicate the means of achieving the goal, and not the goal itself.

Object of research. This is a process or phenomenon that creates a problem

situation and is selected for study (for example, the technology of jellied sweet dishes).

The subject of research in the qualification work is the regularities of the functioning and development of the object, its various qualities, properties, etc. The subject of research is contained within the boundaries of the object.

The object and subject as categories of the scientific process are related to each other as general and particular. Example of subject: technology of lemon jelly using furcellaran.

The scientific novelty of the results obtained is one of the main requirements for the topic of the work. It must contain a solution to a new scientific problem or new developments that expand the existing boundaries of knowledge in a certain field of science.

A brief abstract of new scientific or practical propositions (solutions) proposed by the student personally is provided. It is necessary to show the difference of the obtained results from previously known ones, to describe the degree of novelty (*first obtained, improved, further developed)*.

The novelty of the work and the topic are organically linked. Novelty can be associated both with old ideas, which is expressed in their deepening, concretization, additional reasoning, demonstration of possible use in new conditions, in other areas of knowledge and practice, and with new ideas put forward personally by the applicant.

Publications. Indicate publications on the topic of the work, if any.

Main part (chapters)

The content and results of the research should be presented logically, with references to scientific publications (if necessary) and avoiding unsubstantiated statements. In order for the qualification work to acquire logical consistency and systematicity, its main part is divided into sections, subsections, paragraphs and sub-paragraphs. Thus, sections, typically include:

− subdivisions (numbering consists of two numbers separated by a dot),

− points (numbering – three numbers),

− subpoints (numbering – four numbers).

CONCLUSIONS

After the main part of the qualification work, general conclusions are formed, the volume of which should not exceed 1.5...2 pages. Of course, conclusions should be made for each section of the qualification work (generalized results of a specific issue).

The general conclusions set out the most important scientific and practical results obtained during the performance of the qualification work, which should contain the formulation of the solved scientific problem, its significance for

science and practice, and answers to the tasks set.

PROPOSALS

It is advisable to offer recommendations on the scientific and practical use of the obtained results. It is worth emphasizing the possibility of implementing the results of one's own research work into production.

LIST OF sources used

When writing a master's thesis, a master's student must necessarily refer to the authors and sources from which he borrowed materials or individual results.

The list of sources used can be placed in one of the following ways:

– in the order of appearance of references in the text,
– in alphabetical order of the first author's last name or title,
– in chronological order.

Bibliographic description of sources is compiled in accordance with current standards in library and publishing. Bibliographic description of the list of used sources can be compiled in accordance with one of the styles included in the recommended list of international styles for publication design or DSTU GOST 7.1:2006 "System of standards for information, library and publishing. Bibliographic record, bibliographic description. General requirements and rules for compilation".

APPENDICES

After the bibliographic list, the qualification work contains appendices. The appendices include supporting material necessary for the complete perception of the work. They are drawn up in the form of technological schemes, tables, diagrams, graphs, drawings, etc.

If appendices are drawn up on subsequent pages of the work, each such appendix should begin on a new page. The appendix should have a title printed at the top in lowercase letters with the first capital letter symmetrically relative to the text of the page. In the middle of the line above the title, the word "Appendix" is printed in lowercase letters with the first capital letter and a capital letter denoting the appendix.Appendices should be designated sequentially with capital letters of the Ukrainian alphabet, with the exception of the letters Г, Е, З, И, Ю, Й, О, Ч, Б, for example, Appendix А, Appendix В, etc. One appendix is designated as Appendix А.

Illustrations, tables and formulas placed in appendices are numbered within each appendix.

3. PROCEDURE FOR PROTECTION OF QUALIFICATION WORKS

3.1. Providing qualification work to the department

A properly completed qualification work is submitted to the department and the scientific supervisor for review.

The qualification work is prepared in the state language and must be submitted in hardcover.

The qualification work is signed by the author, the heads of individual sections of the work (subject to the recommendations of the department), the scientific supervisor, and the head of the department.

The qualification work in electronic, printed and bound form remains at the department.

According to the calendar plan, the student must submit the work in parts for review, and by the deadline set by the schedule, submit the completed qualification work for review to the scientific supervisor.

In the event of a positive review by the scientific supervisor, the work is registered at the department and submitted for consideration to the head of the department, who must make a decision on the student's admission to the defense of the work at the EC meeting.

Qualification work must be reviewed. *Reviewing* is entrusted to highly qualified specialists (teachers and scientists) of SNAU (internal review), leading specialists of production, scientific and design organizations (external review). The composition of reviewers is approved by order upon submission of the head of the department.

A review from the enterprise (institution, organization) on the basis of which the research was conducted is certified by the signature of its manager and the corresponding seal. This document is necessary to confirm the authenticity of the materials provided in the final qualification work regarding the activities of the enterprise-object of the research.

When reviewing a final qualification work, it is recommended to determine:

– the novelty of the formulation and development of the problem;

– use of scientific research methods;

– the reasoning behind the conclusions and the validity of the proposals;

– the ability of a master's degree applicant to clearly, competently and with good reasoning present the material, and to format it correctly;

– shortcomings and comments regarding the content of the work and its design;

– conclusion on the possibility of admission to defense.

The review is provided in writing and contains a general conclusion

regarding the recommendation for defense, indicating the assessment according to the accepted knowledge assessment scale at SNAU. The review form is presented in Appendix I.

In order to determine the quality and degree of readiness for the defense of the final qualification work, the graduation department organizes its preliminary defense with a mandatory presentation by the student of the main provisions.

The preliminary defense of the final qualification work is held with the involvement of specialized specialists of the department, with the participation of the head of the educational and professional program, and is regulated by the department's order with a schedule that is brought to the attention of the student.

The commission makes a generalized conclusion about the readiness of the final qualification work for defense, which it places a corresponding mark in the individual plan for the completion of the final qualification work.

After successfully passing the preliminary defense, the final qualification work is submitted for consideration to the head of the department, who makes a conclusion on recommending it for defense at a meeting of the EC.

Students whose final qualification theses were positively assessed during the preliminary defense and review by the head of the final department are admitted by the dean to the defense at the EC meeting no later than 5 days before the start of its work (in accordance with the "Regulations on the Examination Commission for Certification of Higher Education Applicants at SNAU"). Within the same period, the student submits a bound final qualification work to the department.

If formal inconsistencies are identified, including in the formulation of the topic, the name of the enterprise (organization) based on the materials of which the research was conducted, etc., the final qualification work is not registered, is not accepted for review, and is not allowed to be defended.

The student does not have the right to make changes to the qualification work after its registration.

The title page of the submitted work contains the signatures of: the student, the scientific supervisor, the head of the relevant educational and professional program, and the scientific consultant.

3.2. Defense of qualification work

The defense of the qualification work takes place in the presence of the appointed examination committee with the mandatory use of electronic means (for example, PowerPoint).

The student prepares a 10–12-minute presentation using the necessary illustrative material – a visual illustration of the relevant statements during the presentation – the content and quality of which is checked by the scientific

supervisor. The number of copies of the illustrative material must correspond to the quantitative composition of the EC. A sample of the design of the title page of the illustrative material is given in Appendix G.

General provisions for writing a report.

Preparing a quality report ensures the success of the overall preparation for the defense of the final qualifying thesis. The report should contain a concise summary of the main results on the topic of the final thesis and conclusions.

The overall goal of the report is not to simply read a prepared text, but to convey and reveal scientific results based on the work performed. The speaker's speech should show the importance and value of the work performed, the relevance of the chosen topic, and reflect the personal contribution to solving the tasks set.

At the defense, members of the examination committee (EC) assess, first of all, the degree of readiness of the student to defend the final qualification work, and pay attention to the following:

– relevance of the work, compliance of the conclusions with the tasks set;

– the content of the main part of the qualification work,

– the sufficiency and relevance of the information presented in the handout.

– feedback from the scientific supervisor (positive aspects and shortcomings of the work);

– review (positive aspects and shortcomings of the work);

– compliance with the requirements for design, use of scientific style when writing the work;

– preparation of a list of used sources of work.

The report for the defense of the qualification work should contain 3 main blocks:

– introduction and statement of the problem, determination of its relevance;

– the main part – the results of the work performed;

– testing of results, conclusions and recommendations.

The structure of the report should include:

– greetings;

– relevance of the topic;

– goal, task, object, objects;

– organization of research;

– characteristics of the technological scheme of the dish (product) - analogue;

– modeling of the technological process;

– characteristics of the quality indicators of new raw materials;

– results of research conducted on a given topic (physicochemical, structural-mechanical, functional-technological indicators of new raw materials

and finished products);

– justification of the recipe composition and technological parameters of the production process of new food products;

– results of the assessment of the nutritional, biological value and caloric content of food products;

– analysis of hazardous factors in the production of this product;

– assessment of the economic efficiency of the production of an innovative product;

– list of scientific publications on the topic of the work;

– conclusions;

– end of the report.

Based on the results of the defense and taking into account the feedback of the scientific supervisor and reviewer, the examination committee issues a grade.

3.3. General criteria for evaluating the qualification works

During the completion of the final qualification work, the student demonstrates: the ability to logically and reasonedly present the material, correctly use analytical, statistical, mathematical and other methods of scientific research, conduct experiments; mastery of generalization skills, formulation of conclusions; ability to work with literary sources.

Based on the results of a positive defense, the student is given a differentiated grade on a 5- and 100-point scale. The criteria for evaluating the qualification work and its defense are presented in (Table 3.1; 3.2).

Table 3.1 - Distribution of points for individual stages and elements of the qualification work

No. of the company	Criteria for evaluating the performance of qualification work	Points
1	Correctness of the formulations of the object, goal and objectives of the research.	up to 2
2	corresponds to its topic, the literacy of the structuring of the work, the balance of its sections.	up to 7
3	Systematic presentation of the material, absence of repetitions, logical errors.	up to 7
4	Degree of independence of work (absence of academic plagiarism), presence links.	up to 10
5	Use and mastery of modern literature, current regulatory and legal acts; correctness of calculations, application of methods of economic and statistical analysis, etc.	up to 10

6	Theoretical validity of the main provisions of the qualification work, which are confirmed by selected and systematized factual and statistical material.	up to 10
7	Correctness of design (work as a whole, tables, figures, references, list of sources used)	up to 7
8	Adherence to the work preparation schedule, frequency of consultations with the scientific supervisor, etc.	up to 7
	Together	No more than 60

Table 3.2 - Criteria for evaluating the level of defense of the qualification work by the commission

Number of points	Level of knowledge of a higher education applicant	Evaluation criteria
36 – 40	high	The report of the higher education applicant was thoughtful, structured, contained the main results of the research conducted, the higher education applicant demonstrated fluency in the material on the topic of the research, the answers to the questions of the commission members were complete, the understanding of the material was deep, the basic skills were formed and mastered, the presentation was logical, evidence-based (reasoned), the conclusions and generalizations were accurate, the higher education applicant was familiar with the system of current legislation, the use of professional terminology was correct, the conclusions based on the research results were demonstrated using illustrative material (calculations).
32-36	sufficient	The report of the higher education applicant is well thought out, substantiated, contains the main results of the research conducted, the answers to the questions of the commission members are sufficient, the understanding of the material is deep, the basic skills are formed and mastered, the conclusions and generalizations are accurate; the higher education applicant is oriented in the system of current legislation; the use of professional terminology is correct, the conclusions based on the research results are demonstrated using illustrative material (calculations).

30-32		The report of the higher education applicant is well thought out, substantiated, contains the main results of the research conducted, the answers to the questions of the commission members are complete, the understanding of the material is sufficiently deep, the basic skills are formed and mastered, the conclusions and generalizations are accurate; the higher education applicant is oriented in the system of current legislation; the use of professional terminology is correct. But the presentation is not sufficiently systematized, there are individual errors in the definition of concepts, terminology and generalizations, which are corrected with the help of additional questions from the commission members, individual conclusions of the qualification work are not reflected during the defense, individual conclusions based on the research results are not demonstrated with the help of illustrative material (calculations).
27-30	average	The report of the higher education applicant is not properly systematized, ill-thought-out, the main results of the research are partially disclosed, the answers to the questions of the commission members are unfounded, the understanding of the material is superficial; the higher education applicant is poorly oriented in the system of current legislation; the use of professional terminology is inaccuracy, and individual conclusions based on the research results are not demonstrated using illustrative material (calculations).
24-27		The report of the higher education applicant is not properly systematized, ill-thought-out, the main results of the research are partially disclosed, the answers to the questions of the commission members are unfounded, the understanding of the material is superficial; the higher education applicant is not familiar with the system of current legislation; the use of professional terminology is inaccurate. The conclusions and proposals are not sufficiently substantiated and have a dubious applied nature, the conclusions based on the research results are not demonstrated using illustrative material (calculations).
14-24		The report of the higher education applicant is not properly prepared, the answers to the questions of the commission members are unfounded or absent, the understanding of the material is superficial; the higher education applicant is not oriented in the

		system of current legislation; does not know how to use professional terminology. The work indicates insufficient formation of basic professional skills, there is no justification for the practical and applied significance of the research, the conclusions based on the research results are not demonstrated using illustrative material (calculations).
0-14	low	The report of the higher education applicant is not prepared, the answers to the questions of the commission members are unfounded or absent, the understanding of the material is superficial; the higher education applicant is not familiar with the system of current legislation; does not know how to use professional terminology. The work indicates the lack of basic professional skills, individual conclusions based on the results of the study are not demonstrated using illustrative material (calculations).

Recommended form self-assessment qualifying works presented by the applicant in Appendix J.

4. PRACTICAL RECOMMENDATIONS FOR WRITING INDIVIDUAL SECTIONS OF THE QUALIFICATION WORK

This section discusses in detail the approaches and recommendations for writing individual sections of the qualification paper. Typical tables and calculations are provided, but all of them can be adjusted and completely changed taking into account the specifics of the topic of the paper.

The main part is presented in the following sections:

Section I "LITERATURE REVIEW ON THE SELECTED TOPIC" (monitoring of current trends in production on the topic of work, theoretical justification of relevance, conclusions regarding the provision of target functions of the body and prospects for further research);

Section II "ORGANIZATION, OBJECT, SUBJECTS AND METHODS OF RESEARCH" (choice of research scheme, indication of object and research methods);

Section III "RESULTS OF EXPERIMENTAL RESEARCH, SUBSTITUTION OF PRODUCT COMPOSITION, TECHNOLOGY, OPTIMIZATION OF TECHNOLOGICAL SOLUTIONS FOR OBTAINING FOOD PRODUCTS" (experimental part with analysis and generalization of research results);

Section IV "ANALYSIS OF TECHNOLOGY AND DETERMINATION OF HAZARDOUS FACTORS IN FOOD PRODUCTION";

Chapter V "CALCULATION OF THE EXPECTED ECONOMIC EFFECT FROM THE INTRODUCTION OF A NEW PRODUCT».

4.1. Literature review on the selected topic (SECTION 1)

A literature review is a written work containing a summary description of the state of a selected technological issue, necessary and sufficient for understanding by specialists in this field. In general, a literature review has a specific purpose (orientation of specialists in the information flow), is characterized by specific compositional and stylistic features, contains a summary description of the state of the issue and consists of 4 main points and a conclusion.

Technological aspects of food production on the selected topic. It is worth exploring in more depth the problematic issues that have already been raised in the introduction ("Substantiation *of the relevance of the selected scientific problem")* in a logical sequence. First, it is worth investigating the current state of the industry to which the group of food products determined by the selected topic of the qualification work belongs, then - existing technological problems and propose possible ways to solve these problems. The decisive moment of this point is choosing your own path (direction) for solving problematic technological issues and scientifically substantiating this path.

Characteristics of the recipe components that make up the food products on the selected topic. For a more complete analysis of the selected food technology and diagnostics of the technological process, it is worth providing a description of the main and auxiliary raw materials of the food products (in text or in the form of tables, figures, etc.).

Analysis of existing food production technologies on the selected topic. Description of traditional directions for implementing the technological process of the selected food product.

Substantiation of an innovative solution to a technological problem of food products on a selected topic. It can be implemented by a number of innovative measures. For example, by changing the chemical composition of food products and obtaining a finished innovative food product with an increased content of protein, dietary fiber, vitamins, macro- and microelements, etc. As an innovative solution, it is possible to offer an extension of the shelf life of scientific development due to the introduction of various components, etc. It is possible, for example, to improve the textural characteristics of a new product (relative to a similar product) by introducing various structure-forming agents, etc. A promising innovative solution is the development of resource-saving food technologies, which is achieved by a number of possibilities: replacing more expensive raw materials with cheaper ones; reducing the technological process of

production, etc.

It is worth considering that the proposed innovative food products should be compared with their analogue products in terms of chemical composition, organoleptic, physicochemical, rheological, and microbiological properties.

Conclusions. It is worth making a brief summary of the purpose and objectives of the study.

4.2. Organization, object, subjects and methods of research (CHAPTER 2)

The organization of research includes the development of a general plan for theoretical and experimental research, which is presented in the form of a research flowchart. The research flowchart contains a list of sequential actions for formulating the tasks of the qualification work, selecting a number of laboratory studies (figure, table, text) and implementing the results into practice. An example of the design of a research flowchart is given in Appendix E.

The development of an experimental plan-program includes the name of the research topic, working hypothesis, experimental methodology, plan for creating an experimental situation, list of necessary materials, devices, installations. In some cases, the plan-program includes work on the design and manufacture of devices, apparatuses, devices, their methodological examination, as well as programs of research work at enterprises.

Object and subjects of research.

The object of research is the technology of the developed or improved product.

The subjects of the study are raw materials, semi-finished products used in the technology of preparation of the products being analyzed and developed. All products must comply with the requirements of current regulatory documents. This is confirmed by Table 4.1

Table 4.1 – Characteristics of products used in the work (example)

Product	Regulatory document, the requirements of which must be met by the quality of the product
Drinking water	DSTU 7525:2014
etc.	

Research methods. When performing qualification work, modern research methods are used - standard and special organoleptic, physicochemical, rheological, microbiological methods for determining the quality and safety of raw materials, semi-finished products and finished products; mathematical methods for planning experiments and processing experimental data using

computer technology. It is necessary to provide a brief description of them (it is advisable to allocate up to 10 lines of printed text for each method). Only references to standard methods are allowed.

If the study uses standard methods for determining individual indicators, it is not necessary to describe these methods; it is sufficient to refer to the relevant standard.

The use of **modern information technologies** to increase the efficiency of development consists in collecting information, processing it, visualizing scientific research, maintaining an experiment protocol, preparing a presentation and report, and using various modeling methods. Using modern information technologies, the master's student acquires skills in working with the main components of modern personal computer software and technical means, gets acquainted with the basics of computer-based problem-solving technology, starting from their formulation and construction of appropriate information models and ending with the interpretation of the results obtained using a computer.

4.3. Results of experimental studies, justification of product composition, technology, optimization of technological solutions for obtaining a food product (SECTION 3)

Taking into account various technological factors, it is necessary to propose a draft recipe for a new food product to enable further research of the food product in laboratory conditions and possible adjustments based on the results of these studies.

At the first stage, it is necessary to be guided by organoleptic indicators. Then it is necessary to confirm the improvement by calculating the nutritional and energy value in the form of a table (Appendix D).

Characteristics of the raw material-additive used

The subsection characterizes the organoleptic, physicochemical, and technological properties of the additive used, as well as the changes in the analog dish that will occur after its use.

Determining the amount of additive

At the first stage, the amount of additive is determined based on the organoleptic evaluation, which is presented in the form of Table 4.2.

Table 4.2 - Comparative characteristics of organoleptic indicators of the studied cutlet samples (example)

Product name	**Walnut content, % of meat**	**Product rating on a five-point scale**					**Overall score in points**
		Appearance	**Color**	**Smell, aroma**	**Consistence**	**Taste**	
Chopped poultry cutlets No. 732	-	5	5	5	5	5	25
Sample No. 1	10	5	5	5	4	5	24
Sample No. 2	15	5	5	5	5	5	25
Sample No. 3	20	5	5	5	4	4	23

The table shows that the optimal proportion of the additive is 15% of the meat mass.

Justification of the composition and technology of food products

Analysis of the recipe composition of a new product

In addition to the text description, it is proposed to provide an analysis of the recipe composition of the new product in the form of a table of the following form: (table 4.3.).

Table 4.3 - Analysis of the formulation of a new product

Product name	Number of raw materials per _kg (pcs.) of product, kg		Content, %	Role in the technological process
	B	N		

Determination of nutritional and energy value of a similar dish and a new product

The nutritional and energy value of dishes is calculated using a table, the form of which is given in Appendix D. An analysis of the results obtained is given in the form of text. The calculation is performed on the basis of data on the content of basic nutrients in raw materials and products that are part of the developed dish (product). The calculation is carried out using reference tables "Chemical composition of food products". [23]

Determining the shelf life of food products

All food products consist of certain raw materials that are subject to decay and spoilage during storage. It is impossible to prevent deterioration in quality and spoilage of food products, but it is possible to slow down the processes of deterioration in quality by introducing substances with preservative properties into the food product formulation, selecting a method of technological processing,

using packaging, and observing the necessary storage and transportation regimes for food products.

In the process of improving or developing a new technology for food production by introducing certain food additives, establishing the appropriate ratio of raw material content in the food product recipe, or changing production parameters, it is necessary to predict and determine the impact of the innovation on the shelf life of the food product and its safety.

Individual safety and quality characteristics of food products depend on the specific food product and its production technology, and can be studied through the use of physicochemical and microbiological studies.

Developing the technology of a new dish

When developing technologies, it is necessary to note:

- names of raw materials (products) used, in technological sequence, starting with the main ones;
- norms for laying raw materials (products) by gross and net weight, when using semi-finished products - only by net weight;
- the mass of semi-finished products (if necessary) obtained during the preparation of a dish (product);
- output of semi-finished products and finished dishes (products).

In this section, it is mandatory to provide a table with the recipe of a new food or culinary product using the proposed innovative development in its composition. It is also necessary to provide a technological scheme of the development.

It is worth remembering that a technological scheme is a scheme in which each operation is characterized by all possible technological modes and parameters.

Improvement / development of the equipment and technological scheme for the production of food products

The improvement or development of the technology for producing a food product is completed by the development of a hardware and technological scheme for its production, taking into account the implemented innovations.

In this section, it is necessary to justify the choice of the proposed hardware ***and*** technological scheme for the production of the product, indicating its advantages.

When describing the hardware ***and*** technological scheme, attention should be paid to the following stages:

supply and storage of raw materials and semi-finished products;

preparation and supply of raw materials for production;

receiving finished products;

packaging and wrapping of products (if necessary);

warehousing and shipping of products (if necessary).

The description of the equipment ***and*** technological scheme should include all operations up to the stage of packaging and sending finished products for consumption or storage and indicate the production parameters, storage conditions of finished products according to regulatory documentation or conducted research. When describing technological schemes, the text provides equipment brands and indicates positions according to the equipment and technological scheme.

Optimization of technological solutions for obtaining a food product

The section is drawn up on sheets of A4 paper. Entries and drawings are placed on one side of the sheet. The printed results of the individual assignment programs are filed in the diploma supplements.

Section content:

1) the goal of optimizing a specific technological process according to the topic of research work;

2) initial data, according to the individual task;

3) a figure explaining the original data (if necessary);

4) theoretical formulas and calculations based on the original data;

5) a summary table of input data and results or calculation results (depending on the specific technology);

6) a graph constructed based on the calculation results (if required);

7) conclusions based on the results of the calculations and on the work as a whole.

Modeling objects and a generalized algorithm for developing mathematical models of technological processes

Food production, as a rule, is a sequence of three main operations: preparation of raw materials, direct transformation and obtaining target products. This sequence of operations is embodied in a single complex food technological system (FTS). A modern food enterprise, as a large-scale system, consists of a large number of interconnected subsystems, between which there are relationships of subordination, having a hierarchical structure with three main levels.

A food technological system is understood as a set of physical and chemical production processes and means for their implementation. Thus, a food technological system includes: a recipe composition, the process itself, parameters of technological processes and equipment with the help of which various operations are carried out, means for monitoring and controlling processes and communication between them.

The system interacts with the external environment and can be quantified by a set of input parameters X and output parameters Y (Fig. 4.1).

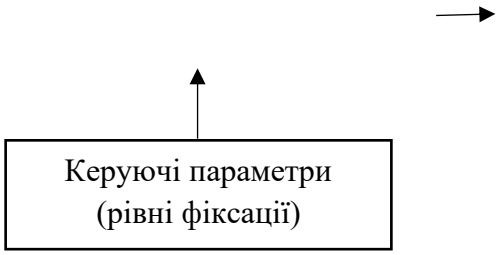


Figure 4.1 – The simplest system structure

The input parameters can be the amount of raw material being processed, its composition, temperature, etc.; the output parameters can be: the amount of finished product, concentration, rheological parameters, shelf life, temperature and other properties. To ensure that the output parameters correspond to the specified values, they are influenced by control variables.

Thus, the CTS is a rather complex object that can be decomposed (decomposed) into component subsystems, or elements. These subsystems are informationally connected to each other and, possibly, to the object's environment.

Sequence of problem solving using experimental and statistical modeling methods

Traditional restaurant production technologies use a predominantly empirical approach to selecting the number of ingredients and parameters of technological operations, which is sometimes unjustified in terms of physicochemical processes, their optimality, and economic feasibility, without taking into account the broad capabilities of technological systems, which reduces the competitiveness of food products.

A scientifically sound approach to the design of technological systems for food production requires the active use of mathematical tools to build models of the technological process and find the optimal solution in order to rationalize the technological cycle of food production.

The tasks of experimental and statistical modeling, like any scientific and technological tasks, are solved according to a certain sequence of actions that allow you to go from setting these tasks to obtaining results. These stages will be present when solving any practical task based on the specified methods.

Stage 1 – formation of the goal and objectives of the research. At this stage, the goals and objectives that should be solved based on the results of the research are directly formulated. This may be, for example, the task of optimizing the object under study. The scope and sources of funding for research, means for its implementation, etc. are also determined here.

Stage 2 – selection of response functions. At this stage, an analysis of all the resulting variables of the object is carried out and those that will be used in the study as response functions are selected. One or more resulting variables can be selected as response functions. It is clear that these variables must, firstly,

correspond to the purpose and objectives of the research, and secondly, correspond to the criteria established for response functions. In addition, at this stage, a scale of numerical estimates of response functions is selected, or if necessary, established, a method is chosen and the measurement error of the required resulting values and registration of the results of these measurements is determined.

Stage 3 – selection of factors. Factors that will be varied in the study are selected so that they significantly affect all or the majority of response functions. In addition, it is obvious that the factors must meet the requirements imposed on them. If necessary, an analysis of the results of previous studies can be carried out or a certain, usually insignificant, number of experiments can be carried out to check the significance of the influence of certain factors. The choice of the number of factors must be approached extremely responsibly. The introduction of unnecessary factors into the study can lead to a significant increase in the volume of experiments. At the same time, failure to include significant factors in the study will lead to incomplete and erroneous results, which will cast doubt on the study as a whole. At the same stage, the areas of determination of factors are established, their main levels and intervals of variation are selected.

Stage 4 – selection of the type of experimental and statistical model and experimental plan. At this stage, in accordance with the task and based on preliminary data on the type of response functions, the order of the future experimental and statistical model is selected (nonlinear programming method, multifactor experiment). Taking into account the number of factors selected for the study, obtain a general form of the model. Based on the selected form of the model, an experimental design is selected, and based on the selected design, the number of individual experiments and the conditions for their conduct are established. In addition, the number of experiments that must be conducted at the same levels of factors – the so-called parallel experiments – is also established here.

Stage 5 – implementation of the experimental plan. At this stage, the experimental research is carried out directly. It is clear that the research is carried out under the conditions stipulated in the plan. From a statistical point of view, when implementing experiments, it is necessary to adhere to the principle of randomization. This principle implies that individual experiments should not be carried out sequentially as specified in the plan, but in random order. This is especially true for parallel experiments.

Stage 6 – regression analysis. This stage is also sometimes called mathematical processing of the experimental results. Regression analysis involves solving the following tasks: assessing the reproducibility of experiments and identifying gross errors in their conduct, calculating numerical estimates of the coefficients of the experimental-statistical model, assessing the significance of

individual components of the model – regressors, and assessing the adequacy of the resulting model to the object of study.

Stage 7 – direct implementation of the research goal, solving the problems set at the first stage based on the developed experimental and statistical models.

1. Stage 1: Formulation of the mathematical description problem	
Problem formulation	Defining the goal and criteria of modeling (selection of rational component composition, optimization of parameters of technological operations)
Selection of input and output parameters of the CTS (determination of experiment factors)	

↓

2. Stage 2: Creating a mathematical description (Development of the structure of the mathematical model)	
Analytical methods	Combined methods
Experimental methods	

↓

3. Stage 3: Creating an algorithm and implementing it in the form of an experimental plan and a central compositional plan	
Choosing a multivariate experiment	Checking the significance and reliability of a mathematical model using the Fisher Criterion
Formulation of the regression equation	

Figure 4. 2 – Generalized algorithm for developing mathematical models

An example of optimizing the nutritional value of a food product is presented in Appendix J.

4.4. Analysis of technology and identification of hazardous factors in food production (CHAPTER 4)

Producing safe products is the primary goal of every food industry enterprise.

To ensure consistently high quality and safety of finished products, the State Standard and laws of Ukraine provide for the mandatory implementation of the international food safety assurance system HACCP at food industry enterprises.

The HACCP system (Hazard Analysis and Critical **Control Points)** is a preventive system for ensuring food safety. It is based on the rational application

of technical and scientific principles to the entire food production chain: from field to **fork.**

The purpose of HACCP is to identify factors dangerous to consumers that may arise throughout the production chain, and to establish controls to ensure product safety for the consumer.

The modern HACCP system is based on seven principles:

Principle 1. Conduct a hazard analysis.

Principle 2. Identification of critical control points.

Principle 3. Setting limit values.

Principle 4. Introduction of a CCP control system.

Principle 5. Establish corrective actions to be taken when observations indicate that a particular CCP is out of control.

Principle 6. Establish a verification procedure to confirm that the HACCP system is operating effectively.

Principle 7. Develop methods for documenting all procedures and maintaining records related to the application of these principles.

This section of the qualification work is carried out during professional practice at industry enterprises by developing a HACCP plan for the production of products on the topic of the qualification work. To write this section, you must use the methodological guidelines for professional practice at food industry enterprises for masters [31].

4.5. Calculation of the expected economic effect of introducing a new product (CHAPTER 5)

The calculation of the economic part of the qualification work should be performed based on the received tasks for the qualification work. It is proposed to consider 2 calculation options.

OPTION A – "Production in a separate unit"

The practical part of calculating the economic efficiency of implementing an innovative product should begin with developing a production program. A feature of forming a production program in market conditions is taking into account the role of marketing in forming a plan for the production and sale of the enterprise's products.

A production program is a system of targeted tasks for the production and delivery of products to consumers in a comprehensive range, assortment, appropriate quality and within the established deadlines according to supply contracts.

- *Nomenclature* is a list of names of individual types of products
- *Assortment* is the variety of products within a given nomenclature.

Production program indicators	**Natural -** characterize the production specialization of the enterprise and its presence in the commodity market
	Value – give a generalized assessment of the company's activities, expressed in monetary terms

The volume of production can be calculated through the number of resources:

$$VP\ (TP) = N*П,$$

where *N – number of employees, people.*

P – labor productivity, which can be expressed as output, UAH/person.

or

$$VP = P*Kv,$$

where *P is the design production capacity of the enterprise, UAH.*

Kv – utilization factor of the design production capacity

The results of the production program calculation are recorded in Table 4.4.

Table 4.4 - Volume of production in value terms

Product type	**Annual production volume, tons**	**Wholesale selling price, UAH.**	**Cost of sales, thousand UAH.**
Total:			

Calculation of capital investments (if any)

To determine capital investments for the purchase, delivery and installation of equipment, an estimate and financial calculation is prepared in the form given in Table 4.5.

Table 4.5 - Estimated costs for the purchase, delivery and installation of equipment

Name	**Number of units**	**Price per unit, UAH**	**Cost thousand UAH.**
Total equipment			
Transportation costs (5% of the cost			

of equipment)			
Installation costs (20% of the equipment cost)			
Together			

Calculation of working capital ratio

To ensure the smooth and efficient operation of the enterprise, it is advisable to calculate the working capital ratio.

The norm of working capital advanced for raw materials, basic materials and purchased semi-finished products is determined by the formula:

$$H = P * Д ,$$

where *H* is the standard of working capital in stocks of raw materials, basic materials and purchased semi-finished products;

P - average daily consumption of raw materials, materials and purchased semi-finished products (based on technological calculations)

D is the stock rate in days.

The average daily cost for the nomenclature of consumed raw materials, basic materials, and purchased semi-finished products is calculated by dividing the sum of their costs for the corresponding quarter by the number of days in the quarter.

Determining the stock rate is the most laborious and important part of rationing. The stock rate is set for each type or group of materials. If many types of raw materials and materials are used, the rate is set for the main types, which take up at least 70-80% of the total cost.

Calculation of product cost

The calculation of the cost of production and sales of products consists of calculating the following main items:

The article "Raw materials and basic materials" provides for the calculation of the cost of raw materials and basic materials (excluding VAT) and the costs of their transportation.

Table 4.6 - Costs of raw materials and basic materials

Raw	Norm per kg/1000kg	Price, UAH/t (m3)	Cost, UAH
Together			

The item "Auxiliary materials" includes costs for the purchase of packaging material and containers.

Recent marketing research shows that 85% of consumers pay attention to food packaging first. Therefore, the effectiveness of product sales can depend on

packaging.

Table 4.7 - Costs for auxiliary and packaging materials

Raw	Norm per kg/1000kg	Price, UAH/t (m3)	Cost, UAH
Together			

To calculate the article "Energy consumption", the norms of electricity and energy resources consumption per unit of output (steam, electricity, water, cold) are used. The student receives the norms of consumption and the actual amount of energy resources consumed during observation during production practice at the enterprise.

Table 4.8 - Energy consumption for technological purposes

Raw	Norm per kg/1000kg	Price, UAH/t (m3)	Cost, UAH
Water, m^3		13.0	
Electricity, kWh		1.93	
…		…	
Together			

Expenses under the item "Basic salary"

The wage fund is the total amount of all expenses for paying employees of the enterprise and social payments. It consists of: the tariff wage fund for hourly and piecework workers, additional payments under bonus systems.

We will take into account:

Annual effective working time fund per 1 worker.

Calendar fund 365 days.

Holidays are 10 days.

Weekends 104 days.

The nominal working time fund is 251 days.

Shift duration 8 hours.

Annual effective working time fund per employee: 1770.4 hours.

Minimum wage: from December 1, 2016 – 1600 UAH (hourly 9.59 UAH); from January 1, 2017 - 3200 UAH (hourly rate 20.18 UAH).

The production rate is determined by dividing the annual production volume by the amount of time worked.

We determine how many hryvnias of basic salary are required per 1 ton of product:

Basic salary / Annual production volume

Table 4.9 - Basic salary

Employee	Hourly tariff rate, UAH/hour.	Basic salary, UAH	Additional salary, UAH	Deductions for social events, UAH	Total wage fund, UAH
Technologist	26.15				
Stacker-packer	20.18				
…					
Together					

Expenses under the item "Additional salary" are accepted in the amount of 10% of the basic salary.

We accept expenses under the item "Social insurance deductions" in the amount of 37.5% of the total payroll (basic and additional salaries in total).

We accept expenses related to the preparation and development of production in the amount of 2% of the basic salary.

The costs of maintaining and operating machinery and equipment are determined depending on the complexity of the innovative solution:

- we accept 20% of the basic salary in the absence of capital investments;
- is calculated by groups of fixed assets as a percentage of the original cost using the initial data given in Table 4.10 (if there are capital investments).

Table 4.10 - Calculation of depreciation and repair costs

Fixed assets	Amortization		Expenses for capital and current repairs		Total expenses thousand UAH
	%	thousand UAH	%	thousand UAH	
Buildings and structures	4.5		5		
Machinery and equipment	12		5		
Others	6		5		
Together					

We accept overhead costs at 50% of the basic salary.

The production cost is the sum of the above cost items.

Administrative costs account for 1.5% of the production cost of products.

Sales costs account for 10% of the production cost of products.

Other operating expenses account for 5% of the production cost of products.

The total cost is the sum of production costs, selling expenses, administrative and other expenses.

Table 4.11 - Costs of production and sales of products

Expense item	Amount of expenses, UAH
Raw materials and supplies, UAH	
Auxiliary materials, UAH	
Energy costs, UAH	
Wage fund, UAH	
Deductions for social events, UAH	
Development costs, UAH	
Equipment repair and maintenance costs, UAH	
Production cost, UAH	
Administrative expenses, UAH	
Other expenses, UAH	
Sales costs, UAH	
Full cost, UAH	

In market conditions, an approach to pricing that takes into account key technological indicators is important for improving the quality of products of processing enterprises, which leads to an increase in yield and improvement in the quality of finished processed products.

Pricing is the process of justifying, approving, and revising prices for new and existing goods and services.

Table 4.12 – Pricing methods

Pricing methods	
1. Cost + profit method C= SV+P, where Ts is the price of the product, CV – cost of production unit, P – expected profit per unit of output	2. Obtaining a target rate of return $C= V_{change} + ((V_{post} + P_{total})/N)$, where Ts is the price of the product, V_{vm} – variable costs per unit of output, $In_{the\ post}$ - fixed costs, P_{total} - expected profit, H – rate of profit
3. Evaluation of consumer value	4. Proportional pricing
5. The “expected profit” method	6. Quick Payback Method

1. Gross profit, thousand UAH:

$$P = B - C,$$

where, P – profit, thousand UAH;

B – cost of products sold, thousand UAH;

C – cost of production, thousand UAH;

2. Profitability of production, %;

$$P = \frac{П}{С} * 100$$

3. Costs per UAH 1 of the value of the produced product, UAH;

$$B_T = \frac{С}{В}$$

4. Production per employee, thousand UAH;

$$B_П = \frac{В}{Ч},$$

where *Ch* is the number of employees, people;

5. Return on investment (subject to calculation of capital investments), UAH;

$$Ф_В = \frac{В}{К_{овф}} \quad ,$$

where K_{ovf} – cost of fixed assets, thousand UAH.

6. Payback period of capital investments (subject to calculation of capital investments), year.

$$T_О = \frac{К_В}{П},$$

where K_B – capital investments, thousand UAH.

Capital investments should be understood as additional investments to introduce the production of a new product (purchase of new equipment, construction of a technological facility, etc.).

The main technical and economic indicators of the project are presented in the form of Table 4.13.

Table 4.13 - Main technical and economic indicators of the project

Indicators	Units of measurement	Indicator
Production capacity of the enterprise by main types of products	t/year	
Annual volume of raw material purchases	t	
Sales revenue	thousand UAH	
Number of industrial and production personnel	Man.	
Production per employee	thousand UAH	
Full cost of goods manufactured	thousand UAH	
Costs per UAH 1 of produced goods	UAH	
Gross profit	thousand UAH	

Net profit	thousand UAH	
Profitability of production	%	
Cost of capital investments	thousand UAH	
Payback period	years	
Fund return		

Draw conclusions about the feasibility of introducing a new product.

When drawing conclusions, one should remember not only the economic, but also the social significance of the resulting dishes.

The social efficiency of the food industry is manifested in improving health, increasing working capacity and life expectancy of the population, as well as in the level of general professional development of employees, better quality of work, etc. From the point of view of public interests, this is a comparison of the actual level of food consumption with a scientifically based norm and the total volume of consumption in kilocalories and in terms of basic food products.

It is advisable to analyze the social effectiveness of the specified project using the following indicators.

– Consumption of staple foods per capita.

– The level of satisfaction of the population's needs for basic food products is calculated as the ratio of the average per capita consumption of basic food products to the scientifically based physiological norms of their consumption.

– Calorie content of average food consumption per capita.

– The level of satisfaction of needs in the total volume of food products (calculated as the ratio of the actual calorie content of the average daily consumption per capita to scientifically based physiological norms).

– Average daily consumption of micro- and macronutrients by the population.

– Production volumes of dietary food products, baby food products, products with medicinal properties, etc. and the level of satisfaction of needs for them.

– Specific weight of expenses.

An example of calculating the economic efficiency of work (food product) is presented in Appendix J.

OPTION B – "Improvement of the existing recipe for a dish from the menu"

A restaurant establishment must be competitive, meet customer needs in service and delicious food. Therefore, a diverse menu is key to the full and effective functioning of a cafe.

At the beginning, you should determine for whom the innovative

improved product will be produced, that is, determine the price audience of consumers.

Next, we determine the composition of the components of the new dish compared to the traditional one.

Table 4.14 - Costs of raw materials and basic materials

Raw	Traditional product			Innovative product		
	Norm for 1 serving, g	Price, UAH/kg	Cost, UAH	Norm for 1 serving, g	Price, UAH/kg	Cost, UAH
Together:						

The item "Auxiliary materials" includes costs for the purchase of packaging material and containers.

Recent marketing research shows that 85% of consumers pay attention to food packaging first. Therefore, the effectiveness of product sales can depend on packaging.

Table 4.15 - Costs for auxiliary and packaging materials

Raw	Traditional product			Innovative product		
	Norm for 1 dish, g	Price, UAH/kg (m3)	Cost, UAH	Norm for 1 dish, g	Price, UAH/kg (m3)	Cost, UAH
Together:						

To calculate the article "Energy consumption", the norms of electricity and energy resources consumption per unit of output (steam, electricity, water, cold) are used. The student receives the norms of consumption and the actual amount of energy resources consumed during observation during production practice at the enterprise.

Table 4.16 - Energy consumption for technological purposes

Raw	Traditional product			Innovative product		
	Norm per kg/1000kg	Price, UAH/t (m 3)	Cost, UAH	Norm per kg/1000kg	Price, UAH/t (m 3)	Cost, UAH
Water, m 3		11.40			11.40	
Electricity, kWh		1.9302			1.9302	
Steam, t		36.0			36.0	
Cold						
Together:						

Thus, the procedure for setting prices for dishes and culinary products in restaurant establishments (enterprises) is regulated by the Law of Ukraine dated 03.12.90 No. 507-XII "On Prices and Pricing". According to this law, restaurant establishments (enterprises) independently set selling prices for their own products and purchased goods.

The calculation of the costs of kitchen products is carried out in Calculation Cards, separately for each dish (portion). The calculation is made by outputting the bill for 100 portions or for a separate portion. To prepare the calculation, the assortment of dishes and culinary products of the enterprise and the norms of laying raw materials are determined in accordance with the Collection of Recipes and Raw Material Prices.

Calculation cards are registered in a special register after being signed by the persons responsible for the correct setting of sales prices.

Table 4.17 - Calculation of an updated menu dish

Name of products (components of the dish)	Consumption rate per 1 serving, g	Price, UAH	Total cost for 1 dish, UAH.	Margin level, %
x	x	x		

Restaurant enterprises' markups can range from a minimum (zero) to a maximum (limit) level and are set depending on the enterprise's pricing policy, which takes into account various pricing factors. The main pricing factor is the cost of raw materials and the markup, which is set as a percentage of the cost of each individual product, regardless of the dishes for which this product is used. However, the pricing process can also be determined by market conditions and demand, and the approach chosen by the enterprise depends on the concept of the restaurant establishment for specific menu items.

It is advisable to differentiate mark-ups by types and categories of enterprises, and within each category, mark-ups should be set depending on the

type and group of products to which a given dish or culinary product belongs. The assignment of dishes and culinary products to a particular group is carried out according to their labor intensity. For example, if we take the mark-up for gastronomic products that do not require heat treatment as a unit, then the marginal mark-up can be set in proportion to the corresponding labor intensity coefficients, which are: for cold appetizers with a side dish - 1.5; for lunch dishes - 2.0; for cheap dishes of increased labor intensity (flour, cereal, vegetable) - 2.5.

The calculation of the selling price is carried out as follows:

– determine the range of dishes in accordance with the menu plan, according to which the cost estimate is drawn up;

– establish norms for adding raw materials to a particular dish in accordance with recipe books;

– determine the prices of raw materials to be included in the calculation;

– calculate the selling price of a set of raw materials for a portion of a dish by adding the cost of each raw material item and adding to this amount the amount of the catering markup and value added tax.

Important: the cost of salt and spices used to prepare dishes or served at the table is included in the calculation of the cost of first, second courses and cold appetizers based on the norms for their investment per 100 servings of dishes at the selling price.

The set price of the dish remains unchanged until the set of raw materials or their cost changes.

Table 4.18 - Calculation of selling prices and planned gross revenue from the sold innovative product

No.	**Group of dishes**	**Daily production volume, units**	**Selling price, UAH**	**Cost of sales, thousand UAH (daily)**	**Cost of sales (gross income), thousand UAH (annual)**
Together:		x	x		

Note: The cost of sales for the year is determined by multiplying the cost of sales per day by the number of working days per year.

Based on the calculation of the cost of products sold, it is necessary to calculate the production program for this product of the restaurant establishment, which will make it possible to determine the main indicators of the project's effectiveness.

The calculation of the production program is presented in Table 4.19.

Table 4.19 - Volume of production in value terms

Name products	**Output products in year, unit**	**Current wholesale price for 1 serving (__ g), UAH**	**Cost of goods products, thousand UAH.**
Innovative product			
Traditional product			

Let's summarize the main technical and economic indicators for the production of an innovative product for a specific restaurant establishment.

Table 4.20 - Main technical and economic indicators of the project

No.	**Indicators**	**Units of measurement**	**Traditional product**	**Innovative product**
1	Production capacity of the enterprise by main types of products	portions		
2	Sales revenue	UAH		
3	Full cost of goods manufactured	UAH		
4	Costs per UAH 1 of produced goods	UAH		
5	Gross profit	UAH		
6	Profitability	%		

Draw a conclusion about the feasibility of introducing a new product to the menu.

An example of calculating the economic efficiency of work (culinary dish) is presented in Appendix C.

LIST OF REFERENCES

Main literary sources

1.Law of Ukraine “On Entrepreneurship”. Bulletin of the Verkhovna Rada of Ukraine with amendments and supplements introduced by the laws of Ukraine dated 21.12.1999 No. 1328–XIV.

2.Law of Ukraine “On Enterprises in Ukraine”. Bulletin of the Verkhovna Rada of Ukraine dated March 27, 1991, No. 24.

3.Law of Ukraine "On Protection of Consumer Rights". Resolution of the Verkhovna Rada of Ukraine dated 15.12.1993.

4.DSTU ISO 9000-2001 "Quality management systems. Basic provisions and vocabulary".

5.DSTU ISO 9001-2001 "Quality management systems. Requirements".

6.DSTU ISO 9004-2001 "Quality management systems. Guidelines for improving performance."

7.DSTU 3410-96 UkrSEPRO certification system. Basic provisions.

8.DSTU 3413-96 UkrSEPRO certification system. Procedure for product certification.

9.DSTU 3414-96 UkrSEPRO certification system. Production certification. Procedure for implementation.

10. DSTU 3415-96 UkrSEPRO certification system. System register.

11. DSTU 3416-96 UkrSEPRO certification system. Procedure for registration of voluntary certification objects.

12. DSTU 3279-95 "Standardization of services. Basic provisions".

13. DSTU 3008-95 “Documentation. Reports in the field of science and technology. Structure and rules of design”

14. DSTU 4161-2003. DSTU 4161-2003. Food safety management systems. Requirements.

15. Decree of the Cabinet of Ministers of Ukraine “On Standardization and Certification”.

16. Law of Ukraine “On Labor Protection”. Resolution of the Verkhovna Rada of Ukraine dated 01.01.2004.

17. Law of Ukraine "On the Quality and Safety of Food Products and Food Raw Materials".

18. Law of Ukraine "On Environmental Protection".

19. Decree of the Cabinet of Ministers of Ukraine “On Standardization and Certification”.

20. Code of Ukraine "On Administrative Violations".

21. Resolution of the Cabinet of Ministers of Ukraine dated 09.11.96 No. 1371 “On improving the quality and safety control of food products”.

22. Rules for the operation of public catering establishments (enterprises) (Order No. 219 of July 24, 2002 of the Ministry of Economy and European Integration of Ukraine).

23. Cherevko O.I., Malyuk L.P., Deynychenko G.V. Collection of normative documents of state regulation in the sphere of restaurant business. – Kharkiv: PKF “Favor LTD”, 2003. – 440 p.

24. Collection of recipes for national dishes and culinary products: for community enterprises. Food of all forms of ownership / O.V. Shalyminov, T.P. Dyatchenko. – K.: Ariy, 20 22. – 992 p.

25. Technology of functional food products: monograph / M.I. Peresichnyi, M.F. Kravchenko and others; edited by M.I. Peresichnyi − Kyiv: Kyiv National

University of Trade and Economics, 2008. − 718 p.

26. Collection of recipes for dishes and culinary products (technological charts) using biologically active additives / [Peresichny M.I., Kravchenko M.F., Korzun V.N. and others]; under the direction of M.I. Peresichny. − K.: Kniga, 2004. – 428 p.

27. Human nutrition and the modern environment: theory and practice / Peresichnyi M.I., Kravchenko M.F., Korzun V.N., Grigorenko O.M. − K.: KNTEU. 2002. − 526 p.

28. Organization of service at restaurant enterprises: textbook, edited by N.O. Pyatnytska. − K.: KNTEU, 2005. − 632 p.

29. Organization of Service in Restaurant Enterprises: Textbook [for Higher Educational Institutions] / Edited by N. O. Piatnytska – 2nd revised and supplemented edition. – Kyiv: Center for Educational Literature, 2011 – 584 p.

30. Methodological instructions for completing professional practice at food enterprises of the industry for students of the 1st year of the Master's degree program in specialty 181 "Food Technologies" / compiled by F.V. Pertsevoy, O.Yu. Melnyk, S.M. Sabadash, N.V. Bolgova, O.G. Sereda. - Sumy, 2021. - 32 p.

Additional

31. Innovative technologies in industry enterprises: Laboratory practical course for 1st year students of specialty 181 "Food technologies" of full-time and part-time forms of study, educational degree "Master" / compiled by O.Yu. Melnyk, O.Yu. Koshel, S.P. Bokovets, - Sumy: Sumy National Agrarian University, 2022. - p. 44.

32. Methodology of scientific research: a textbook for students and postgraduates of specialty 181 “Food technologies” / Ladyka V. I., Shilman L. Z., Pertsevoy F. V. and others / edited by Ladyka V. I. – Kherson: OLDI-PLUS, 2021. – 22213.

33. Mazaraki A.A. Design of restaurant establishments: a manual for higher education institutions / Mazaraki A.A., Peresichnyi M.I., Shapoval S.L.; ed. A.A. Mazaraki. − K.: KNTEU, 2008. − 307 p.

34. Simakhina G. O., Naumenko N. V. Achievements and prospects for the implementation of innovations in the food industry of Ukraine. International scientific journal "Grail of Science". 2021. No. 5 (June). Pp. 109 – 115.

35. Radchuk O.V. Methodological guidelines for the preparation of course and qualification papers by full-time and part-time students for all areas and specialties of the Faculty of Food Technologies / O.V. Radchuk, Y.V. Nazarenko, N.K. Bashtova. − Sumy: SNAU, 2014. − 61 p.

36. Modern achievements of food science: a textbook for students and postgraduates of specialty 181 “Food technologies”: In 2 parts. Part 2 / Ladyka V.

I., Shilman L. Z., Pertsevoy F. V. and others / edited by Ladyka V. I. – Kherson: Oldi+, 2022. – 352 p.

37. Statistical collection "Scientific and innovative activity in Ukraine" in 2016 [text] / Responsible for the publication O.O. Karmazin. — Kyiv: State Statistics Service of Ukraine, 2017. — 141 p.

38. Strashinsky V.I. Innovative activity of food industry enterprises of Ukraine: trends and priorities / V.I. Strashinsky // Scientific works of the National University of Food Technologies. — 2016.— Vol. 22, No. 1. — P.42—50.

39. Sereda O. G. A new type of functional raw material with increased protein content for biscuit products / O.G. Sereda, O.Yu. Melnyk // Technical Sciences and Technologies, (2(28), 102–110. https://doi.org/10.25140/2411-5363-2022-2(28)-102-110

40. Functional drink technology with chia seeds / Wang Haiyan, Melnyk Oksana, Li Bo // Grain Products and Compound Feed, Vol.21, I.1(81)/ 2021 – p. 20-30 DOI: 10.15673/gpmf.v21i1.2093

41. Technology of functional food products / Mostova L.M. and others. – Kh.: Kharkiv, 2013. – 450.

42. National standardization. Basic provisions: DSTU 1.0:2003. – [Valid from 2003-07-01]. – K.: Derzhspozhyvstandart Ukrainy, 2003. – 10 p. – (National standard of Ukraine).

43. National standardization. Rules for the construction, presentation, design, approval, acceptance and designation of technical conditions: DSTU 1.3:2004. – [Valid from 2005-01-01]. – K.: Derzhspozhyvstandart Ukrainy, 2004. – 16 p. – (National standard of Ukraine).

44. National standardization. Rules for registration of regulatory documents: DSTU 1.6:2004. – [Valid from 2004-10-01]. – K.: Derzhspozhyvstandart Ukrainy, 2004. – 22 p. – (National standard of Ukraine).

45. National standardization. Standardization and related activities. Terms and definitions of basic concepts: DSTU 1.1:2001. – [Valid from 2001-07-01]. – K.: Derzhspozhyvstandart Ukrainy, 2001. – 38 p. – (National standard of Ukraine).

46. On the safety and quality of food products: Law of Ukraine, 23.12.1997 [Electronic resource]. – Access mode: http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?page=1&nreg=771%2F97-%E2%F0 (access date: 1.11.2011). – Screen title.

47. Products manufactured according to the technical conditions of Ukraine (as of January 1, 2009): reference book: in 2 parts / [responsible for the publication T. I. Lyubomyrov]. – Kyiv: State Enterprise “Ukrmetrteststandart”, 2009.

48. On the Protection of Consumer Rights: Law of Ukraine, 12.05.1991 [Electronic resource]. – Access mode: http://zakon2.rada.gov.ua/laws/show/1023-12 (access date: 1.11.2011). – Screen

title.

49. On the basic principles of state supervision (control) in the sphere of economic activity: Law of Ukraine, 5.04.2007 [Electronic resource]. – Access mode: http://zakon2.rada.gov.ua/laws/show/877-16 (access date: 1.11.2011). – Screen title.

50. On standardization: Law of Ukraine, 17.05.2001 [Electronic resource]. – Access mode: http://zakon1.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=2408-14 (access date: 1.11.2011). – Title from the screen.

51. On standardization and certification: Decree of the Cabinet of Ministers of Ukraine, 10.05.1993 [Electronic resource]. – Access mode: http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=46-93 (access date: 1.11.2011).

52. On standards, technical regulations and conformity assessment procedures: Law of Ukraine, 1.12.2005 [Electronic resource]. – Access mode: http://zakon1.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=3164-15 (access date: 1.11.2011).

53. Methodological instructions for the design of course and qualification papers / O.V. Radchuk, Y.V. Nazarenko, N.K. Bashtova. – Sumy, SNAU, 2014.

54. National Standard of Ukraine. Information and Documentation. Bibliographic Reference. General Provisions and Rules of Compilation. DSTU 8302:2015. Kyiv SE "UkrNDNC" 2016.

APPENDICES

Appendix A
Application addressed to the head of the graduating department regarding approval of the topic of the qualification work

To the Head of the Department
_____
Full name of the head of the department
_____
Student's full name
gr.___, _____ course,
_____
__
_____
specialty, specialization, faculty

Statement

I would like to ask you to approve the topic of the final qualification work:
_____
_____
_____
_____
_____
according to materials
_____
_____
_____
____
full legal name of the enterprise/organization/institution
_____ _____
date student signature

Appendix B
Qualification work assignment form
MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
SUMY NATIONAL AGRARIAN UNIVERSITY

Faculty of Food Technology
Department of Food Technology
Higher education degree Master's degree
Specialty: 181 "Food Technology"

APPROVE
Head of the Department
food technology
Last name
_____
"____"_____ 20__ year

TASK
for the student's qualifying work
Ivanov Ivan Ivanovych
(last name, first name, patronymic)

1. Topic of the qualification work: Improving the technology of dessert paste using walnut kernel concentrate
head of qualification work _____
(academic degree, academic title, surname, first name, patronymic)
approved by order of the higher educational institution dated "___"___20__ No.___
2. Deadline for student submission of work_____
3. Initial data for work _____
_____
4. Contents of the calculation and explanatory note (list of issues that need to be developed): Introduction; Section 1. Analytical review of the literature; Section 2. Organization, object, subjects and methods of research; Section 3. Justification of the content of the studied additive / recipe of a new product / parameters of the technological process of food production; Section 4. Improvement / development of food technology / study of quality indicators of new food products; Section 5. Analysis of hazardous factors in food production (HACCP); Section 6. Analysis and generalization of the results of economic research on the technology of the selected product and ways of its application in production conditions; Conclusions; List of sources used; Appendices.
5. List of graphic material (photographs, drawings, diagrams, graphs, tables) Visual support of qualification work using Power Point
6. Work section consultants

Section	Last name, initials and position consultant	Signature, date	
		the task was given	task accepted
Chapter 6			

7. Date of issue of the task __ _____

CALENDAR PLAN

No. salary	Name of the stages of qualification work	Deadline for completion of qualification work stages	Manager's signature
1	**Section 1** Analytical review of the literature (on the selected topic).		
2	**Chapter 2** Organization, object, subjects and methods of research.		
3	**Section 3** Justification of the content of the investigated additive / formulation of a new product / parameters of the technological process of food production.		
4	**Section 4** Improvement / development of food technology / study of quality indicators of new food products.		
5	**Chapter 5** Hazard Analysis and Critical Control Points (HACCP) in Food Production		
6	**Chapter 6** Analysis and generalization of the results of economic research on the technology of the selected product and ways of its application in production conditions.		
7	Text of conclusions, proposals, formation of annexes		
8	Submitting an electronic version of the work to the repository		

Student _____ _____

(signature) (surname and initials)

Supervisor _____ _____

(signature) (surname and initials)

Appendix B
Title page of the work (example)

MINISTRY OF SCIENCE AND EDUCATION OF UKRAINE

SUMY NATIONAL AGRARIAN UNIVERSITY

Faculty of Food Technology

Department of Food Technology

To the defense
allowed
Head of the Department
food technology
Last name
_____

QUALIFICATION WORK

for the second level of higher education

on the topic: "Improvement of the technology of filling based on sour milk cheese for pancakes using sesame seed concentrate"

Done by: _____ _____
(signature) (last name, initials)

Group: _____

(Scientific) supervisor: _____ _____
(signature) (last name, initials)

Sumy 202-

Appendix D
Illustrative material (example)
Sumy National Agrarian University
Department of Food Technology

ILLUSTRATIVE MATERIAL
TO THE DEFENSE REPORT
QUALIFICATION WORK

on the topic:

_____

_____

topic name

Student of ___ course, __ group, specialties (code, name) specialization (name)	_____ *student's signature*	Last name, first name, patronymic
Scientific advisor academic degree academic title	_____ *manager's signature*	Last name, first name, patronymic

Sumy 20…..

Appendix D

Table D.1 - Characteristics of nutritional and energy value of dishes (example)

No. salary	Dish and ingredients	Index according to nutritional value tables	Net weight	Contents								Energy value kcal	
				Protein, g			Fats, g			Carbohydrates, g			
				In 100 g	In the dish	Including animals	In 100 g	In the dish	Including vegetable	In 100 g	In the dish	In 100 g	In the dish
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
	Semolina porridge with apples	1.205											
	Semolina		19	10.3	1.9	–	1.0	0.19	0.19	67.7	12.8	238	45.22
	Milk	Pasteurized, 3.5% fat	195	2.79	5.4	5.4	3.5	6.8	–	4.69	9.1	61	118.9
	Apples		35	0.4	0.14	–	0.4	0.14	0.14	9.0	3.15	45	15.75
	Butter	Unsalted	5	0.5	0.02	0.02	82.5	4.1	–	0.8	0.04	748	37.4
	Sugar		10	–	–	–	–	–	–	99.98	9.9	387	38.7
	Total I		230		7.46	5.42		11.23	0.33		34.9		255.9
	Total II		100		3.24	2.35		4.83	0.13		15		110.1
	Total including losses		100		3.2	2.3		4.7	0.1		14.8		108.9

Appendix G
Example
Economic justification of the production of yeast puff pastry in the confectionery shop of the supermarket "Domashny"

The purpose of this work is a project for the production of yeast puff pastry in a supermarket confectionery shop with a capacity of 50 kg per shift to meet the demand of the population by creating cost-effective production in order to obtain stable income.

The calculation of the production program is presented in Table 1.

Table 1 – Volume of production in value terms

Product type	Production volume per shift, kg	Cost of sales, UAH
Dough	50	2,000.0
Together:		**2,000.0**

To ensure the production of products that meet modern requirements, the workshop does not require radical reconstruction, both in terms of replacing outdated equipment and introducing modern technologies.

Based on the project calculations for technology and data from technological practice, we calculate the raw materials and basic materials for dough production.

Table 2 - Calculation of the cost of raw materials and basic materials

Type of raw material	**Raw material requirement per shift, kg**	**Purchase price per 1 kg, UAH.**	**Total cost of raw materials, UAH**
Flour in g	25.0	9.5	237.5
Eggs	2.0	20.0	40
Butter	12.5	60.0	750
Milk	12.5	6.0	75
Sugar	1.0	12.0	12
Salt	0.3	5.0	1.5
Yeast	0.2	90.4	18.08
Together:	x	x	**1134.08**

Next, we determine the quantity and cost of auxiliary materials for dough production. In this case, only the cost of auxiliary materials for technological purposes is taken into account, which is calculated directly, based on the costs of the entire production output and the cost of auxiliary materials.

The calculations are presented in Table 3.

Table 3 - Calculation of the cost of auxiliary raw materials and materials

Type of raw material	Material requirement, kg (pcs.)	Purchase price per 1 kg, UAH.	Total cost, UAH
Food film	2.6	4.5	11.7
Together:	x	x	**11.7**

Let's calculate the salaries of employees in the confectionery department of a supermarket.

Table 4 - Calculation of the payroll fund

Number of employees	Basic salary, UAH	Additional salary, UAH	Accruals for wages (37.5%), UAH.	Basic salary fund, thousand UAH.
2	240.0	24.0	99.0	**363.0**

The calculation of energy costs is carried out based on the norms of energy consumption per ton of product and their cost, based on the data of the energy and electrical engineering calculation of the project, which are given in the feasibility study.

Table 5 - Calculation of fuel and energy costs for product production

Types of fuel and energy	Norm per 1000 kg of product	Production cost rate per shift	Cost per unit, UAH	Total expenses thousand UAH.
Electricity	65 kW	3.25	1.93	6.28
Water	9 m^3	0.45	13.0	5.85
Total	x	x	x	**12.13**

The costs of maintaining and operating machinery and equipment are determined depending on the complexity of the innovative solution:

- we accept in the amount of 20% of the basic salary in the absence of capital investments = **48 UAH.**

We accept general production costs at 50% of the basic salary = **120 UAH.**

Administrative costs are 1.5% of the production cost of products = **25.33 UAH**

Selling expenses are 10% of the production cost of products = **UAH 168.89.**

Other operating expenses are 5% of the production cost of products = **89.9 UAH.**

After the calculations are made, a summary table of production costs is compiled.

Table 6 - Cost of production

No.	Expense items	Sum, thousand UAH
1	Raw materials and supplies	1134.08
2	Supporting materials	11.7
3	Fuel and energy for technological purposes	12.13
4	Salary with deductions	363.0
5	Equipment maintenance and operation costs	48.0
6	General production costs	120.0
7	Production cost	**1688.91**
8	Administrative costs	25.30
9	Selling expenses	168.89
10	Other expenses	**89.9**
11	Full cost price	**1973.00**

The summary indicators of the enterprise's activities are given in the table

Table 7 - Technical and economic indicators of the enterprise

Indicators	Unit of measurement	Value
Volume of production in current prices	UAH	**2000.0**
Full costs of production and sales of products	UAH	**1973.00**
Costs per UAH 1 of produced goods	UAH	**0.99**
Profit from production activities	UAH	**27.0**
Profitability of production	%	**1.3**
Number of industrial and production personnel	persons	**2**
Labor productivity	UAH/person	**1000.0**

The calculations made showed the feasibility of introducing the production of yeast puff pastry in the confectionery shop of the supermarket. The profit of the enterprise per shift will be 27 UAH. Despite the minimal profit, the goods are of high quality. Therefore, profit is expected from the sale of finished products from the dough - pies, buns, etc.

Appendix C
Example
Development of an innovative product – beef stew with kelp

When developing a new recipe for meat stew with kelp, the concept of consumer market marketing research was taken into account. It was determined that for a restaurant establishment, bringing such a product to the market is usually accompanied by a certain degree of risk. Therefore, it was decided to perform some economic calculations that would help find out what profit the enterprise can get from introducing this novelty for the production of a dish from the menu. The cost of production is one of the most important indicators of the efficiency of production of any product. It accumulates all current costs and includes the totality of costs, expressed in monetary terms, for the manufacture and sale of products.

The goal of expanding the restaurant menu by creating a new dish - meat stew with kelp - is to ensure the demand of the population for this type of product. The main consumers are people who suffer from iodine and microelement deficiency, athletes and those who want to lose weight. After all, seaweed strengthens the body, saturating it with useful substances.

To ensure the production of products that meet modern requirements, the hot shop of the facility does not require a radical reconstruction, both in terms of replacing equipment and introducing modern technologies. Therefore, it was decided not to make additional capital investments.

Based on the project calculations for technology and data from technological practice, we calculate raw materials and basic materials for the production of canned goods (Table 1).

It is advisable to calculate the cost of new manufactured products based on the cost of raw materials and supplies, energy costs and marketing costs due to possible advertising on the tables of a new product from the establishment's menu. It is not appropriate to calculate indicators such as wages, compensation for wear and tear of special tools and equipment for specific purposes and other special costs, costs of maintenance and operation of equipment, general production costs, etc. in this case, because they relate to the entire range of dishes of the establishment.

The item “Raw materials” includes the cost of raw materials that are part of the products being manufactured. In addition, this item includes the cost of purchased materials to ensure a normal technological process and product packaging.

Table 1 - Costs of raw materials and basic materials

Raw	"Stewed beef with kelp"			Traditional product		
	Norm for 1 serving, g	Price, UAH/kg	Cost, UAH	Norm for 1 serving, g	Price, UAH/kg	Cost, UAH
Beef 1 grade	300	29	8.7	370	29	10.73
Beef fat	100	10	1	100	10	1
Laminaria	52	389	20,228	0	0	0
Together:			**29.92**			**11.73**

The costs of auxiliary materials are summarized in Table 2.

Table 2- Costs for auxiliary materials

Raw	"Stewed beef with kelp"			Traditional product		
	Norm for 1 serving, g	Price, UAH/kg	Cost, UAH	Norm for 1 serving, g	Price, UAH/kg	Cost, UAH
Table salt	1.2	3.0	0.0036	1.2	3.0	0.0036
Fresh onion	40	2.0	0.08	40	2.0	0.08
Black pepper	0.5	189.0	0.0945	0.5	189.0	0.0945
Allspice	0.3	223.0	0.0669	0.3	223.0	0.0669
Bay leaf	0.2	376.0	0.0752	0.2	376.0	0.0752
Water	100	2.5	0.25	100	2.5	0.25
Together:			**0.57**			**0.57**

Energy costs are entered in Table 3.

Table 3 - Energy consumption for technological purposes

Raw	Traditional stew / Stew with kelp		
	Norm per 100kg	Price, UAH/t (m 3)	Cost, UAH
Water, m 3	7.58	11.40	86.4
Electricity, kWh	33.97	1.78	60,463
Steam, t	4.6	36.0	165.6
Together:			312,463
For 1 serving			0.31 UAH

Taking into account demand, it is advisable to set the price for a new dish 30% higher than traditional products.

Table 4 - Calculation of an updated menu dish

Name of products (components of the dish)	**Consumption rate per 1 serving, g**	**Price, UAH**	**Total cost for 1 dish, UAH.**	**Margin level, %**
Beef 1 grade	300.0	29.0	8.7	30%
Beef fat	100.0	10.0	1	30%
Laminaria	52	389.0	20,228	30%
Table salt	1.2	3.0	0.0036	30%
Fresh onion	40.0	2.0	0.08	30%
Black pepper	0.5	189.0	0.0945	30%
Allspice	0.3	223.0	0.0669	30%
Bay leaf	0.2	376.0	0.0752	30%
Water	100	2.5	0.25	30%
Together:			30.50	41.0

Let's summarize the production cost of the newly created and traditional product:

Table 4 - Costs of production and sales of products

Raw	**Traditional product**	**Beef with kelp**
Raw materials and supplies, UAH	11.73	29.92
Auxiliary materials, UAH	0.57	0.57
Energy costs, UAH	0.31	0.31
Production cost, UAH	12.61	30.8
Sales costs, UAH	1.26	3.08
Full cost, UAH	**13.87**	**33.88**

Selling costs are taken as 10% of the production cost.

Summing up the calculations performed, it is necessary to analyze the economic efficiency of the recipe improvement project according to the main indicators.

The main technical and economic indicators of the project are presented in the form of Table 6.

Table 6 - Calculation of selling prices and planned gross income from the sold innovative product

No.	**Dish**	**Daily production volume, units**	**Selling price, UAH**	**Cost of sales, thousand UAH (daily)**	**Cost of sales (gross revenue), UAH (annual)**
1	Beef stew with kelp	3.0	41.0	123.0	41000.00
2	Beef stew	3.0	30.0	90.0	30000.00

Let's summarize the main technical and economic indicators for the production of an innovative product for a specific restaurant establishment - beef stew with kelp.

Table 7 - Main technical and economic indicators of the project

No.	**Indicators**	**Units of measurement**	**Traditional product**	**Beef with kelp**
1	Production capacity of the enterprise by main types of products	portions	1000	1000
4	Sales revenue	UAH	30000.0	41000.0
5	Full cost of goods manufactured	UAH	18000.0	33800.0
6	Costs per UAH 1 of produced goods	UAH	0.60	0.82
7	Gross profit	UAH	12000.0	7200.00
8	Profitability	%	40.0	17.5

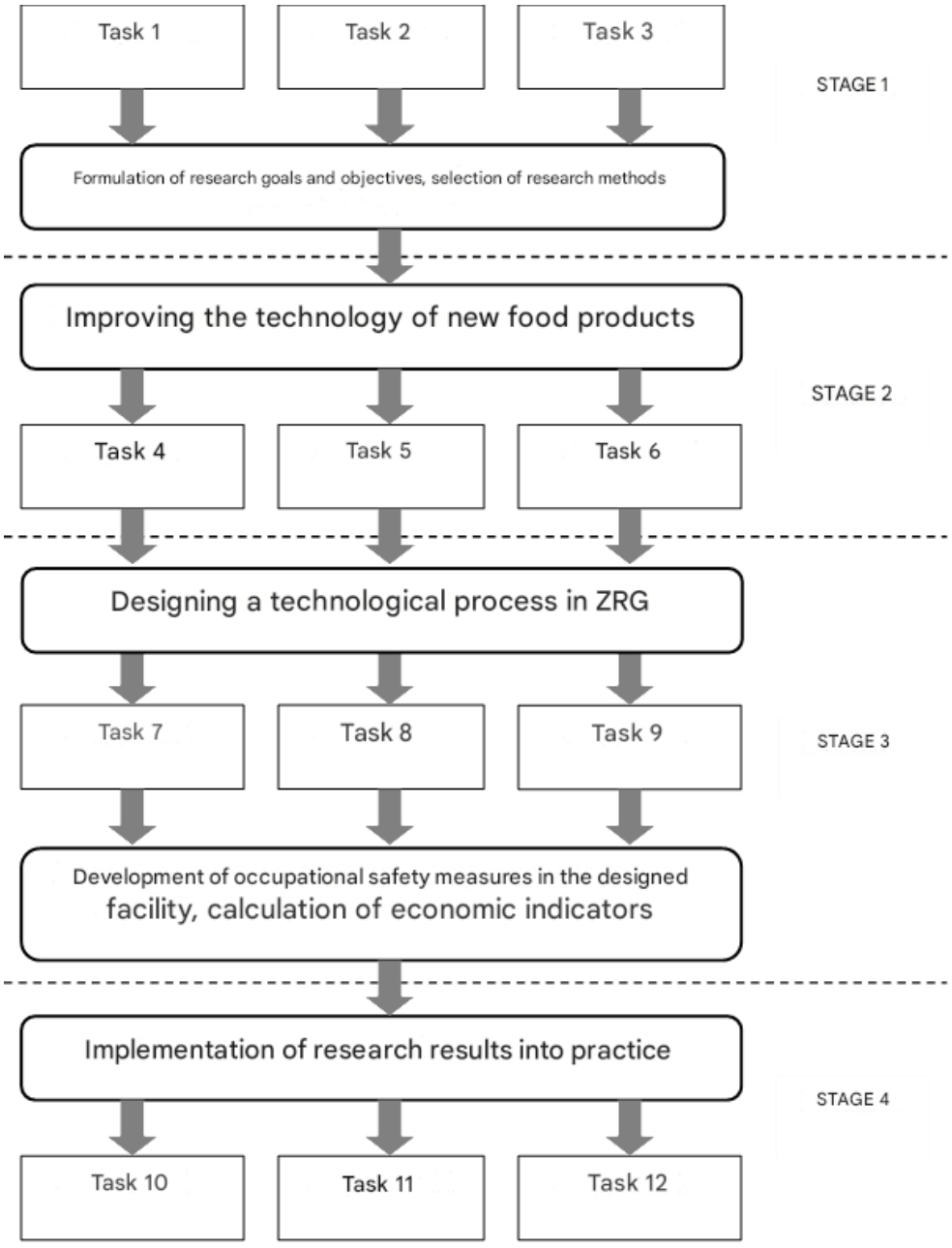
Conclusion:

The calculations carried out conclude that the production of a new product will be expedient. The price for 1 serving of such stew will be 41.0 UAH/serving. Which is 30% more than the traditional product. But taking into account the demand among the selected category of the population for such products, the production will be profitable.

The social effect of producing kelp stew will be to improve the functional nutrition of the population of the Sumy region (which, according to research by domestic scientists, does not receive enough iodine components by 54%), especially in the difficult ecological situation after the Chernobyl disaster.

APPENDIX E

BLOCK DIAGRAM FOR CONDUCTING ANALYTICAL, EXPERIMENTAL RESEARCH AND CALCULATIONS



APPENDIX G
Mathematical modeling process of heat treatment of semi-finished product from freshwater mollusk

The current task of studying the technology of semi-finished products from freshwater mollusks is to optimize the heat treatment process using mathematical modeling, namely the use of an orthogonal central compositional plan, to determine the rational cooking time. During optimization, the interdependence and magnitude of four factors are taken into account: moisture content, degree of penetration, and the value of structural-mechanical indicators and indicators of organoleptic studies. Data on the chemical composition and structural-mechanical indicators are taken from those obtained in the process of studying the raw material - the soft body of freshwater mollusks. The developed technology of semi-finished products from freshwater mollusks is taken as a basis. The response function is interpreted and studied, after which conclusions are drawn regarding the optimization of the heat treatment time.

The problem is determining the optimal time of heat treatment, since the soft body of freshwater mollusks has increased rigidity, which is associated with a high content of collagen fibers, so in order to satisfy organoleptic preferences and at the same time maximally preserve the consumer properties of the semi-finished product from freshwater mollusks, which is difficult to carry out experimentally, since the scope of the study is too large.

To achieve the set goal, the following tasks were performed:

– development of an orthogonal central compositional plan with four (n) factors for optimizing the heat treatment time with each factor fixed at five levels, taking into account the minimum and maximum cooking time of a semi-finished product from freshwater mollusks with unchanged basic characteristics of the raw materials;

– evaluation of the organoleptic properties of each parallel determined during the experiment;

– present the obtained results in the form of a 3D model to determine the optimal heat treatment time.

Organoleptic assessment of the quality of the finished product was carried out using analytical methods - qualitative and profile analysis.

The essence of the profile method is that the complex concept of one of the organoleptic indicators (consistency, taste and smell, color) was presented as a set of components (descriptors), which were evaluated by experts according to indicators of quality, intensity, and order of manifestation.

To perform optimization, the response function is formed as a complete second-order quadratic polynomial for n=4, which is given in (Form.1).

To determine the coefficients of the polynomial, a second-order orthogonal central compositional design (OCCD) is used.

$$Y=b_0+b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_{12}x_1x_2+b_{13}x_1x_3+b_{14}x_1x_4+b_{23}x_2x_3+b_{24}x_2x_4+b_{34}x_3x_4+b_{123}x_1x_2x_3+b_{124}x_1x_2x_4+b_{234}x_2x_3x_4+b_{1234}x_1x_2x_3x_4+b_{11}x_1^2+b_{22}x_2^2+b_{33}x_3^2+b_{44}x_4^2 \quad (1)$$

An orthogonal central compositional plan is a plan in which the planning matrix X is constructed in such a way that the matrix $C=X_tX$ is diagonal. We also use this approach when constructing second-order plans.

A plan is called central if all points are located symmetrically about the center of the plan. CSC – central symmetrical rectangular compositional plan.

To determine whether a CCP can be used in research, 3 criteria are used, the data on which are well known:

1. Student's t-test/Student's t-test is a general name for a class of methods for statistical hypothesis testing (statistical tests) based on comparison with the Student's t-test . The most common cases of using the t-test are related to testing the equality of mean values in two samples.

2. Cochrane criterion – used to compare three or more samples of the same size

3. F-test or **Fisher's exact test** (F-test, φ*-test) is any statistical test whose test statistic, when the null hypothesis is met, has a Fisher distribution (F-distribution).

The optimization parameter is the optimal time of heat treatment (cooking) of a semi-finished product from freshwater mollusk at approximate maximum values of changes in chemical composition, structural and mechanical indicators, and organoleptic values.

In the central compositional plan, each factor is fixed at five levels, taking into account the maximum and minimum values of the indicators of the selected factors while leaving the main properties of the semi-finished product unchanged, which are given in Table 4.5.

Table 1

Optimization factors and their fixation levels affecting the optimization of the heat treatment time of a semi-finished product from freshwater molluscs

Factors influencing optimization		Levels of fixation of factors and their magnitudes				
		–1.414	–1	0	1	1,414
x1	Shear stress, kPa	9.1	14.7	17.3	20	25.5
x2	Cutting work, kJ	132.2	126.6	133.3	140	134.4
x3	Penetration, kPa	3.4	8.6	10.3	12	24
x4	Moisture content, %	78.1	74.8	79.9	85	81.7

The experimental design, the results of direct measurements, and their initial analysis are presented in Table 2 and Table 3, respectively.

Table 2

Orthogonal central compositional plan with four (n) factors for optimizing the time of heat treatment of semi-finished freshwater mollusk products

No.	x_0	x_1	x2	x3	x4	$x_1^2 - 0{,}8$	$x_2^2 - 0{,}8$	$x_3^2 - 0{,}8$	$x_4^2 - 0{,}8$
1	1	1	1	1	1	0.20	0.20	0.20	0.20
2	1	–1	1	1	–1	0.20	0.20	0.20	0.20
3	1	1	–1	1	–1	0.20	0.20	0.20	0.20
4	1	–1	–1	1	1	0.20	0.20	0.20	0.20
5	1	1	1	–1	–1	0.20	0.20	0.20	0.20
6	1	–1	1	–1	1	0.20	0.20	0.20	0.20
7	1	1	–1	–1	1	0.20	0.20	0.20	0.20
8	1	–1	–1	–1	–1	0.20	0.20	0.20	0.20
9	1	1	–1	1	1	0.20	0.20	0.20	0.20
10	1	–1	–1	1	–1	0.20	0.20	0.20	0.20
11	1	1	1	1	–1	0.20	0.20	0.20	0.20
12	1	–1	1	1	1	0.20	0.20	0.20	0.20
13	1	1	–1	–1	–1	0.20	0.20	0.20	0.20
14	1	–1	–1	–1	1	0.20	0.20	0.20	0.20
15	1	1	1	–1	1	0.20	0.20	0.20	0.20
16	1	–1	1	–1	–1	0.20	0.20	0.20	0.20

Table 3

Results of direct measurements

No.	y_1	y_2	y_3	y_4	$\bar{y}_j$	s_j^2	$\hat{y}$	$\bar{y}$	$s_{ад}^2$
1	2	3	4	5	6	7	8	9	10
1	8.8	11.9	31.7	12.41	16.2	109.56	16.2	16.3	0.017
2	7.8	10.1	25.9	10.56	13.6	68.73	13.6	13.7	0.005
3	6.9	10.1	31.5	13.71	15.6	120.36	15.6	15.4	0.037
4	6.4	11.4	26.1	11.67	13.9	71.99	13.9	13.7	0.038

Continuation of table 3

1	2	3	4	5	6	7	8	9	10
5	8.0	7.1	31.1	14.16	15.1	123.82	15.1	15.3	0.034
6	7.4	8.4	25.7	11.02	13.1	72.41	13.1	13.3	0.033
7	6.5	8.4	31.3	12.75	14.7	128.23	14.7	14.7	0.007
8	5.6	6.6	25.5	13.26	12.7	83.61	12.7	12.6	0.019
9	7.1	11.6	31.7	11.64	15.5	120.55	15.5	15.6	0.006
1	2	3	4	5	6	7	8	9	10
10	6.2	9.8	25.9	10.20	13.0	76.64	13.0	13.0	0.000
11	8.6	10.3	31.5	14.22	16.2	110.24	16.2	16.0	0.020
12	8.0	11.6	26.1	11.61	14.3	64.33	14.3	14.2	0.020
13	6.3	6.9	31.1	12.53	14.2	134.33	14.2	14.3	0.017
14	5.8	8.1	25.7	12.26	13.0	78.82	13.0	13.1	0.017
15	8.2	8.6	31.3	14.01	15.5	117.50	15.5	15.5	0.001
16	7.2	6.8	25.5	11.26	12.7	76.60	12.7	12.6	0.007

As a result of the research, the coefficients of the regression equation were obtained. A statistical analysis of the model as a whole and its coefficients separately was carried out. The results are summarized in Table 4.

Table 4

Results of statistical analysis of the experiment

(n=5, P≥0.95)

	x0	x1	x2	x3	x4	$x_1^2 - 0{,}8$	$x_2^2 - 0{,}8$	$x_3^2 - 0{,}8$	$x_4^2 - 0{,}8$	
∑xi*ycp	358.6	21.1	5.6	8.1	4.3	0.0	–0.6	0.6	–0.7	
∑xi^2	25	20.0	20.0	20.0	20.0	8.0	8.0	8.0	8.0	
bi	14.34	1.05	0.28	0.41	0.22	0.00	–0.07	0.08	–0.09	
S2{bi}	15.13	1.61	1.61	1.61	1.61	4.04	4.04	4.04	4.04	
S{bi}	3.89	1.27	1.27	1.27	1.27	2.01	2.01	2.01	2.01	
you	3.69	0.83	0.22	0.32	0.17	0.00	0.04	0.04	0.04	
ti–tcr	1.63	–1.23	–1.84	–1.74	–1.89	–2.06	–2.02	–2.02	–2.02	
	x1x2	x1x3	x1x4	x2x3	x2x4	x3x4	x1x2x3	x1x2x4	x2x3x4	x1x2x3x4
∑xi*ycp	1.8	0.6	–1.3	0.5	0.1	0.0	–1.3	–0.1	–0.1	0.5
∑xi^2	16	16	16	16	16	16	16	16	16	16
bi	0.11	0.04	–0.08	0.03	0.00	0.00	–0.08	–0.01	–0.01	0.03
S2{bi}	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02
S{bi}	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42

Continuation of table 4

you	0.08	0.03	0.06	0.02	0.00	0.00	0.06	0.00	0.01	0.02
ti–tcr	–1.98	–2.03	–2.00	–2.04	–2.06	–2.06	–2.00	–2.06	–2.05	–2.04
∑Sj2		2421.28		∑Sad		0.466		Sy2	96.85	
Sj2max		134.33		Sad^2		0.0233				
G		0.06		F		0.000240		α	0.05	
m–1		3.00		k1		4				
N		25.00		k2		20		f_1	24.00	
G_{kr}		0.19		$F_{kp(table)}$		2.87				
$G–G_{kr}$ =		–0.13		$F–F_{kp}$ =		–2.86975952		t_T	2.06	
($G<G_{cr}$) homogeneous dispersion				$F<F_{kp}$ the statistical model is significant, the regression equation is reliable						

After constructing the central compositional plan, performing all necessary calculations, and determining the regression equation as reliable, the coefficients in formula 1 are replaced by those determined in the studies, which makes it possible to determine the optimal time for heat treatment of the semi-finished product.

As a result, the resulting regression model in coded units has the form:

$$Y=14.34+1.05x_1+0.28x_2+0.41x_3+0.22x_4+0.11x_1x_2+0.04x_1x_3–0.08x_1x_4+0.03x_2x_3–0.08x_1x_2x_3–0.01x_1x_2x_4–0.01x_2x_3x_4+0.03x_1x_2x_3x_4–0.07x_2^2+0,08x_3^2–0.09x_4^2 \quad (2)$$

To determine the optimal heat treatment time according to the given parameters, a 3D model was constructed by the least squares smoothing method using the software package for statistical analysis Statistica, which is shown in Fig. 1.

After studying graphical data, direct measurement results, and regression equations, the optimal heat treatment time was determined for 11 samples.

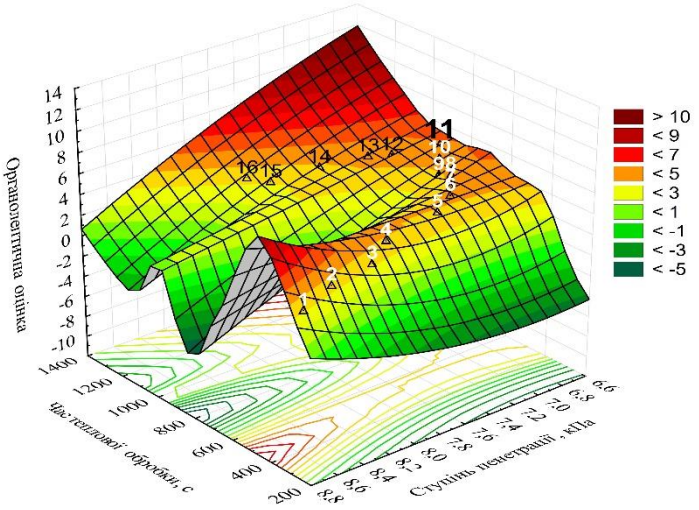


Fig. 1. 3D model of optimization of heat treatment time of semi-finished product from freshwater mollusk

Translating the model into the language of the experimenter is called the interpretation of the model. The influence of a factor on the optimization parameter is equal to the magnitude of the regression coefficient. Since Y tends to a maximum, an increase in coefficients with a "+" sign is favorable for the optimization parameter. Factors whose coefficients are insignificant (from the point of view of an experimenter with experience in the field under study) are not interpreted and do not have a significant impact on the optimization parameter.

Therefore, after studying the graphical data, the results of direct measurements and interpreting the regression equation, the optimal heat treatment time was determined to be (15±1) minutes, at which the values of structural and mechanical indicators and moisture content are closest to the optimal with an organoleptic assessment of 14.25.

Appendix C

An indicative list of topics for qualification papers.

1. Improving the technology of minced poultry products using dietary fiber.
2. Improving the technology of dishes with sour milk cheese using berry kylie.
3. Improving bar technology using cashew nuts.
4. Improving the technology of dumplings using modified starch.
5. Improving the technology of bakery products using amaranth processing products.
6. Improving the technology of chopped semi-finished products using plant raw materials.
7. Improving the technology of cold fish dishes using sesame.
8. Improving pizza dough technology using cuttlefish ink.
9. Improving sugar cookie technology using nut meal.
10. Improving the technology of bakery products using heat-stable fillings.
11. Improving the technology of snack products using flax seeds.
12. Improving the technology of health drinks using plant raw materials.
13. Improving the technology of culinary products using walnut cake.
14. Improving the technology of semi-finished meat products in a dough shell for functional purposes.
15. Improving the technology of pasta products with increased nutritional value.
16. Improving the technology of culinary products using gluten-free flours.
17. Development of cheese snack technology.
18. Improving the technology of bakery products using viburnum processing products.
19. Improving the technology of cheese balls with natural food additives.
20. Improving the technology of semolina pudding using sesame processing products.
21. Improving the technology of butter buns using apricot powder.
22. Improving the technology of cheeses based on secondary raw materials.
23. Improving the technology of yogurt enriched with dietary fiber.
24. Development of technology for meat semi-finished products with an extended shelf life.
25. Improving the technology of halloumi cheese production.

26. Improving marinade technology for the production of natural meat products and semi-finished products.
27. Development of cider technology based on chokeberry processing derivatives.
28. Development of food coloring technology based on mulberry processing derivatives.
29. Improving the technology of drinks for children based on recycled materials.
30. Improving the technology of functional ice cream production.

Appendix I

Declaration of Academic Integrity

I, _____, a student of group _____ of Sumy National Agrarian University, undertake to adhere to the principles of academic integrity while performing the qualification work. I am informed that in the event of my violation of academic integrity while performing the qualification work, I will have to bear academic and/or other types of responsibility and disciplinary measures may be applied to me for violation of academic integrity and ethics of academic relations, including the cancellation of the qualification work with subsequent expulsion from the university.

I also realize that in the future, the procedure for depriving me of my higher education degree and corresponding qualification may be applied to me if a knowingly committed violation of academic integrity is not detected during the verification of the qualification work for the presence of text borrowings in accordance with the procedure established at the university using licensed software products.

date signature

Appendix I

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

SUMY NATIONAL AGRARIAN UNIVERSITY

REVIEW

_____

position, last name, first name, patronymic of the reviewer

for qualifying work

S VO "Master"

specialty 181 "Food Technology"

Student_____

Groups _____ course_____ ___

Subject _____ _____

_____ ____

Review content

1. Scope of qualification work _____

number of sheets of explanatory note (A4) _____ _

2. Relevance of the topic to the direction of training _____

_____

_____ ___

3. Assessment of the quality of the graphic part (compliance with the ESKD standards):_____

_____ ___

_____ ___

4. Positive qualities of the work in general:_____

_____

5. Main disadvantages: _____ __

_____ ___

_____ ___

6. Overall assessment of the work: _____

_____ ___

Reviewer _____

signature date

Appendix J

Recommended form self-assessment qualifying works applicant

Criterion	Level			Comment
Review literature built around mainproblems, used most relevant modern research by topic, clearly displayed connection between the tasks set in the work, and previous research	+	+ +	+ + +	
Specific and accurate information provided about methods and data (quantity, temperature, duration, sequence, conditions, arrangement, dimensions, etc.), methods related to other research.	+	+ +	+ + +	
Given specific results with explanationsand analysis, comparison with results others research, shown clear connection problems with received results,	+	+ +	+ + +	
Suggestions for improvement were provided, which supported by appropriate justifications(forecast, model, etc.)	+	+ +	+ + +	
The conclusions contain connection with the most important aspects of the previous chapters, summarykey results, demonstrated connection between this work and available research focused on tangible results, their possible application is indicated; presented limitation, on which trace to direct future research.	+	+ +	+ + +	
The list of references is complete and sufficient forsolution research tasks	+	+ +	+ + +	
Work framed fully in accordance to requirements	+	+ +	+ + +	
Work not contains printing and grammaticalerrors	+	+ +	+ + +	

Melnyk Oksana
Pertsevoy Fedor
Samilyk Maryna
Helikh Anna
Turchina Svitlana

METHODOLOGICAL INSTRUCTIONS FOR PERFORMING QUALIFICATION WORK

Sumy, Regional University of Agriculture, Sumy National Agrarian University, 160 Gerasym Kondratiev St.

Signed for printing: 2024 Format A5: Font Times New Roman Circulation: ___ copies Order _____Printable sheets