

BAKIYEVA ANARA BAGLANOVNA
DEVELOPMENT OF THE DESIGN OF THE CUTTING MECHANISM OF
THE TOP IN ORDER TO IMPROVE THE MODES OF GRINDING OF
FOOD RAW MATERIALS
ANNOTATION

the dissertation work of PhD-doctoral student Bakiyeva A.B. for the degree of
Doctor of Philosophy (PhD) in the specialty 6D072400 - Technological machines
and equipment

The relevance of the work. The message of the first President of the Republic of Kazakhstan to the people of Kazakhstan states: "The main task is to increase labor productivity and export of processed agricultural products by 2.5 times by 2022. All measures of state support should be directed to the large-scale attraction of modern agricultural technologies in the country. We must use the best experience of managing the industry by introducing flexible, convenient standards and attracting "gray heads— - reputable foreign experts in the field of agriculture."

"Intensification of technological processes is one of the main directions of technological progress in the meat industry. Along with a significant increase in the volume of meat products, the meat industry faces the task of improving the quality and assortment of products with the most comprehensive and rational use of raw materials."

In the production of sausages and semi-finished products, cutting processes are widely used, which significantly affect the quality of raw materials and finished products.

Industrial meat grinders or tops are one of the most basic types of equipment designed to produce minced meat. The complexity of the processes occurring in the spaces of the transporting and cutting mechanisms of the tops imposes significant changes on the kinetics of the process. The study of changes in the structural and mechanical characteristics of raw materials and technological parameters of the process is the basis for improving the process of grinding meat raw materials.

In carrying out this dissertation, special attention is paid to the theory of grinding and the optimization of minced meat grinding modes.

The theoretical basis for solving the problems in this work is based on the fundamental works of academician Rebinder P.A., professors: Peleev A.I., Ivashov V.I., Gorbатов A.V., Kafarov V.V., Rogov I.A., etc. A. The scientific and methodological basis for this study was the works in the field of grinding and rheology of food masses, technology of food production and food engineering of

such scientists as: Kosoy V.D., Machikhin Yu.A., Machikhin S.A., Ospanov A.A., Chizhikova T.V., Smirnov M.B., Tumenov S.N., Kakimov A.K., and others.

The purpose of the dissertation work is to develop the design of the cutting mechanism of the top based on theoretical and experimental research of the cutting process and modes of grinding meat raw materials.

In accordance with the set goal, the following **tasks** are defined in the work:

1. to analyze the process of grinding meat raw materials, the designs of existing tops for grinding meat raw materials, on the basis of which it will be possible to propose a rational design of the working body of the top - grid;
2. to propose an appropriate rheological model of meat raw materials and to carry out a theoretical justification of the proposed design of the cutting mechanism;
3. to conduct a study of the patterns of behavior of the object in the conditions of grinding and describe its mathematical model;
4. conduct experimental studies to determine the rational design parameters of the cutting mechanism;
5. to develop an engineering methodology for the technological calculation of the top, supplementing it with the determination of the lattice throughput based on the Hagen-Poiseuille equation, the operator scheme of the process of mechanical processing of meat raw materials;
6. develop technical documentation, manufacture and test the design of the cutting mechanism - grating for grinding meat raw materials.

The object of the study. The object of the study is a cutting mechanism - a grate for grinding meat raw materials, meat raw materials (beef, lamb, horse meat, pork and chicken).

The subject of the study.

1. chemical composition of meat raw materials;
2. changing the water binding capacity of minced meat;
3. changing the maximum shear stress of minced meat;
4. changing the granulometric composition of minced meat;
5. changing the performance of the experimental setup;
6. changing the power of the experimental installation.

Scientific novelty of the work:

- a mathematical description is given and analytical expressions are obtained that characterize the parameters of the meat grinding process and allow controlling its mode;
- the adequacy of the mathematical model based on the study of the forces of interaction of meat raw materials with the cutting mechanism has been verified;

- an engineering technique for calculating the throughput of a knife grate has been developed and a geometric coefficient characterizing this throughput has been proposed;
- the operator scheme of the process of mechanical processing of meat raw materials has been developed.

The main provisions submitted for protection:

- new design of the cutting device (grid) of the spinning top;
- the results of analytical and experimental studies of the process of grinding meat raw materials by the cutting mechanism of the proposed design;
- operator scheme of meat semi-finished products production and engineering methodology of technological calculation of the top.

Scientific and practical significance of the work. An engineering technique for the technological calculation of the top has been developed, supplemented by the determination of the lattice throughput based on the Hagen-Poiseuille equation. On the basis of a complex of studies conducted in laboratory and production conditions, the expediency of using the cutting mechanism of a top for grinding meat raw materials is shown. Based on the results, technical documentation has been developed, a fundamentally new lattice design, the novelty of which is confirmed by the patent for the utility model of the Republic of Kazakhstan No. 2484 and a sample of the lattice of the proposed design has been manufactured and implemented in the IP "Alteev" and in the Semey branch of the Kazakh Research Institute of Processing and Food Industry LLP.

Personal contribution of the author. Development of an engineering methodology for the technological calculation of the spinning top supplemented by the determination of the grid capacity based on the Hagen-Poiseuille equation and the development of the design of the cutting device (grid) of the spinning top.

Approbation of practical results: The main provisions and results of the work were reported at international scientific and practical conferences: "Technologies of food production and examination of goods", Kursk, 06.04.2017; "Technology and technology: ways of innovative development", Kursk, 29-30.06.2017; "Topical issues of sustainable, consumer-oriented technologies of the food and processing industry of the agroindustrial complex", Moscow, 7-8.12.2017; "Actual problems of food production: conditions and prospects of development", dedicated to the 75th anniversary of corresponding member of KazASHN, Doctor of Technical Sciences, Professor E.T. Tuleuov, Semey, 24.11.2017; "Innovative technologies in the food industry: science, education and production", Voronezh, 16.11.2018; "Information technology development of the food industry - trends, strategies, challenges", Moscow, 6.12.2018; "Kazakhstan-cold 2019", Almaty, 20-21.02.2019; "Analysis of equipment for grinding meat and

bone raw materials", Barnaul, AltSTU, 14.03.2019; "Innovative research and development for scientific support of production and storage of environmentally safe agricultural and food products". - Krasnodar, 8-19.04.2019.

Publications. 19 publications have been published on the topic of the dissertation: 9 articles in international conferences; 2 articles in publications recommended by the Committee for Quality Assurance in Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan; 3 articles in scientific journals with a non-zero impact factor (Scopus and Web of Science databases); 1 monograph; 1 analytical review, 2 utility model patents of the Republic of Kazakhstan.

The structure and scope of the dissertation. The dissertation work consists of an introduction, five chapters, a conclusion, a list of sources used and appendices. The main content of the work is presented on 96 pages of the text of the computer set, contains 54 figures, 6 tables, the list of references includes 100 sources from 27 foreign and 9 appendices.

Assessment of the completeness of solutions to the tasks. According to the results of the dissertation work, it can be assumed that the goals and objectives have been achieved:

1. The analysis of the process of grinding meat raw materials and the designs of machines for this process made it possible to identify reserves for improving this process by developing a cutting device - a grid with variable hole diameter.
2. The developed rheological mechanical model and rheological equation show that the behavior of minced meat during grinding is described by a model with an element reflecting the loss of strength of minced meat during cutting. When grinding, the pressure is transferred through the knife to the minced meat, which is crushed at a voltage exceeding the cutting limit voltage.
3. The study of the regularities of the behavior of the object in the conditions of grinding is carried out and its mathematical model is described.
4. The experimental data obtained confirm that the process of grinding meat raw materials can be improved by developing a cutting mechanism consisting of a grid with variable hole diameters with an increase from the periphery to the center.
5. An engineering methodology for the technological calculation of the top has been developed, supplemented by the determination of the lattice throughput based on the Hagen-Poiseuille equation, the operator scheme of the process of mechanical processing of meat raw materials.
6. Technical documentation has been developed, a fundamentally new lattice design, the novelty of which is confirmed by the patent for the utility model of the Republic of Kazakhstan No. 2484 and a sample of the proposed lattice design was

manufactured and implemented in IP "Alteev" and in the Semey branch of LLP "Kazakh Research Institute of Processing and Food Industry".