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1. FOOD SCIENCE AND TECHNOLOGIES

DEVELOPMENT OF WAYS TO REDUCE TECHNOLOGICAL RISKS IN THE PRODUCTION OF SEMI-SMOKED SAUSAGE PRODUCTS

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Abstract. *This article presents a procedure for identifying technological risks of food products using quality tools, including: data collection, identification of the causes and consequences of technological risks, construction of a structural-parametric model for analyzing and predicting technological risk.*

Possible defects in the production of semi-smoked sausages are systematized. The reasons that cause the risk of malfunctions in the production of semi-smoked sausages are identified. Significant technological risks in the production of semi-smoked sausages are analyzed and a methodology for assessing technological risks is developed. Developed an orderly chain of actions to identify, reduce, control technological hazards and prevent them in the production of semi-smoked sausages.

Key words: *risks, stages, sausage, management, factor, tolerance, defects.*

I. INTRODUCTION

The main tasks of the risk management system are to create an organizational culture aimed at meeting the needs of consumers through the production of high-quality products, compliance with the legislative and regulatory framework, which increases the guarantee of products with high and stable quality and safety indicators.

The paper deals with the management of technological hazards that are part of the production risk group. Production risks are determined not only by the specifics of individual technologies, but also by the specifics of individual food industry enterprises. An urgent scientific task is to develop a theoretical basis for solving the problem of risk reduction for food producers, which allows us to assess the risks at all stages of food production.

As a result, the relevance of the work is associated with the identification of technological risks in the production of semi-smoked sausages, quantitative assessment and development of measures to reduce statistically significant risks [1].

II. ANALYTICAL REVIEW OF THE LITERATURE

2.1. International Food Safety and Quality standards

In recent years, the approach to risk management in Kazakhstan has begun to change. The legislative framework for managing food safety, quality and risk indicators has achieved significant development: Codex Alimentarius, ISO 22000, International Food Standard - IFS, Safety Quality Food - SQF, British Retail Consortium Food Standard - BRC, HACCP.

The Codex Alimentarius standards define not only the requirements for food safety indicators, but also additional quality indicators that determine the biological value of products, requirements for sampling, analysis and labeling methods.

ISO 22000 is an international standard that defines the requirements for food safety management systems and covers all organizations in the system of production, supply and marketing of food products.

In general, the ISO 22000 standard has ensured the unity of the requirements for HACCP systems at the international level and their compliance with the requirements of other international standards for management systems [2].

British Retail Consortium Food Standard/BRC (BRC Global)

The British Retail Consortium / BRC published the BRC Global Food Standard in 1998. The fourth version of this document was released in July 2005. The standard is based on a set of HACCP principles, quality management systems, and also regulates the application of production practices (GMP). The standard is intended for manufacturers of all types of food products.

IFS is an international food standard. It is designed to conduct uniform checks of the level of food safety and the quality of manufacturers ' products. It can be used at all stages of production related to agricultural production, in which food products are processed.

In addition to GMP ("manufacturing practices"), the manufacturer develops and maintains a Food Safety and Quality Control Plan, as well as important aspects of maintaining food safety and quality.

When analyzing all of the above standards, one reference can be traced - all standards are based on the principles of HACCP.

The HACCP system and its application guidelines are coded by the Alimentarius Commission's Food Hygiene Committee, a joint programme of the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO). The HACCP system is based on the fact that risks affecting food safety can be minimized or minimized in the production process, rather than in the control of the finished product [3].

2.2. Nature and classification of risks

Risks are the probability of negative events occurring in an enterprise.

A dangerous factor, depending on its origin, is divided into biological, chemical and physical factors that cause harm to the life and health of citizens.

Important elements that serve as a basis for risk classification:

- time of appearance;
- the main factors of occurrence;
- the nature of the consequences;
- origin and others.

Depending on the time of occurrence, threats are divided into retrospective, current and prospective.

The classification of threat risks by field of activity is the most common. According to the areas of business activity, there are usually: production, technological, commercial, financial and insurance risks.

Industrial hazards can be divided into the following categories:

- technical risks - this group includes the risks of investing in innovations;
- the production risks themselves (technological risks);

- transport hazards [4].

In the field of quality management, the following risks are highlighted:

1) anthropogenic hazards - hazards associated with the qualification of employees;

2) information technology threats-threats related to the production process;

3) organizational risks - risks associated with changes in the external environment;

4) Industrial and technical hazards - hazards associated with equipment, tools;

5) material risks - risks associated with the responsibility of subcontractors.

Defects in meat products can occur during production, transportation, storage and manifest themselves in the deterioration of taste, smell, texture and color. The occurrence of defects is determined by the composition and properties of raw materials, non-compliance with technological conditions,sanitary and hygienic conditions of production, transportation and storage, and a number of other factors. The risk of failure can be managed to a certain extent by using methods, tools and tools that allow you to predict the occurrence of a risk event and take measures to reduce the level of risk [5-6].

2.3. Risk management mechanism

2.3.1. Product quality risk management

The risk management mechanism is a sequence of problem solving at all stages of the life cycle in order to obtain a product of guaranteed quality. Risk management is the process of identifying, analyzing, and making decisions about risks that involve minimizing the negative consequences of risk events. Risk reduction in production activities is carried out by applying control or other measures to reduce the negative consequences associated with the risk.

Risk management is the process of identifying and evaluating risks, as well as selecting management methods and tools to minimize risks.

Today, risk management is one of the developing forms of professional activity. The tasks of the risk manager include minimizing all types of risks using effective forecasting methods and, as a result, preventing the occurrence of risk situations. These actions are the essence of the threat management system.

The risk management process in an enterprise is a complex and very important process, as a proper and effective risk management program avoids losses and losses associated with ensuring the quality of goods and services in the enterprise.

Product risk management refers to a correct understanding of the degree of risk that constantly threatens people, property, and financial results of economic activity [7].

2.3.2. The stages of risk assessment

When implementing the risk management process, it is necessary to adhere to a certain sequence of actions. When making a decision, let's take a closer look at the stages of the risk management process.

Stage I. Threats should be adjusted, i.e. limit the number of existing threats according to the" enough " principle. To do this, we use the experience of conducting surveys and interviews with specialists, as well as implementing similar projects.

If we consider threats from the point of view of management: the presence of uncertainty, the need to choose an alternative and the possibility of qualitative and quantitative assessment of the probability of certain threats, objective and subjective factors that affect the increase in the degree of threat, then the processes that hinder the achievement of the goal are identified under the threat.

Stage II. At this stage, a quantitative assessment of the identified risks is carried out, which can be expressed in the relative or absolute level of losses, and the risk is measured by the probability of occurrence of risks and the degree of influence on their occurrence. To determine these indicators, the following gradations are used: high, medium, and low. In practice, however, it is important to quantify the impact of each risk [8].

III. OBJECT, SUBJECT, AND METHODS OF RESEARCH

3.1. Object and methods of research

The object of the study was a semi-smoked sausage product. At work, we used:

- expert method,
- method of analyzing the types and consequences of potential defects,
- method of statistical processing of experimental data.

In the course of the work, generally accepted and standard research methods were used for an objective assessment of quantitative quality indicators.

3.2. Identification of factors leading to the risk of defects in the production of semi-smoked sausages

Defects in meat products may occur during production, transportation, and storage. Defects are manifested by deterioration of taste, smell, consistency and color. The occurrence of a defect is associated with the composition and properties of raw materials, compliance with the technological process modes, compliance with sanitary and hygienic conditions of production, transportation and storage conditions [9].

This stage is the main one, since unidentified defects indicate non-compliance with regulatory requirements for product safety and quality and are accompanied by additional economic costs. The article considers the risk of defects in the production of semi-smoked sausages. Based on the study of the regulatory requirements for the safety and quality of semi-smoked sausages, as well as the requirements for the process of their production and storage, information about possible product defects is systematized in the form of a defect tree.

Figure 1 shows the tree of defects of semi-smoked sausages.

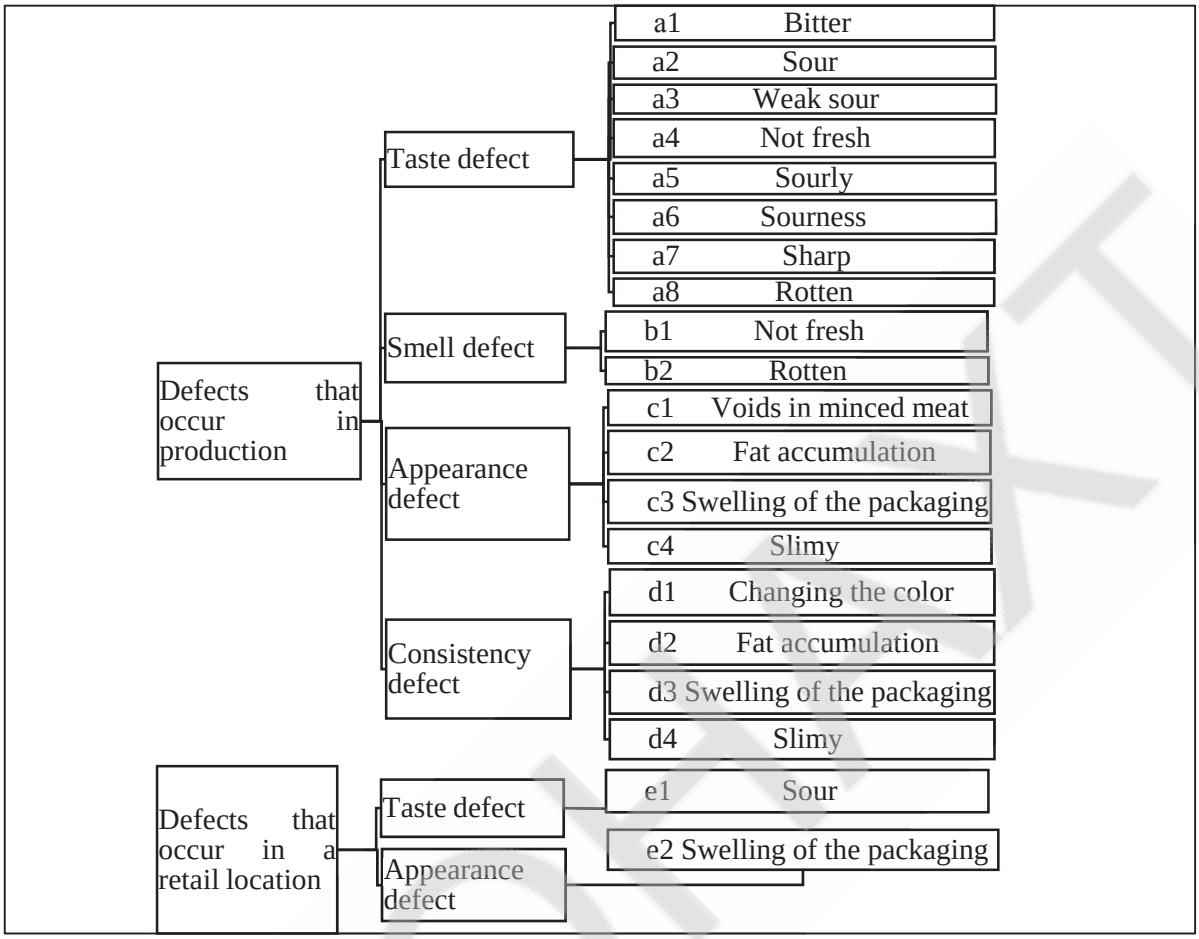

Figure 1. Tree of defects of semi-smoked sausages

Technological hazards in the production of semi-smoked sausages based on the analysis of the causes and risk factors, a form of the Register of Technological Hazards in the production of semi-smoked sausages will be developed. For more effective identification and subsequent monitoring, mandatory risk indexing is recommended, which is registered in the register of technological risks.

IV. RESULTS OF THE WORK

4. Planning and analysis of measures to reduce significant technological risks

4.1. Development of scales for quantifying significant technological risks

In order to conduct a procedure for analyzing and evaluating significant technological risks, we have adapted them according to the FMEA method.

FMEA-potential Failure Mode and Effects Analysis-Analysis of the types and consequences of potential failures.

The method of analyzing the types and consequences of potential defects (FMEA) is an effective tool for improving the quality of developed technical means, aimed at preventing defects or reducing their negative consequences. This is achieved by predicting failures and failures and analyzing the design and production processes carried out during the design stages. The FMEA method allows you to:

- identify the "weak" points of technological processes and take measures to eliminate them when planning production processes;
- making a decision on the suitability of proposed and alternative technological processes and equipment in the development of technological processes;
- to work out the technological process with a different approach that is most suitable, namely: reliability, safety for personnel, identification of potentially defective technological operations, etc.;
- preparation of mass production [10].

The FMEA method is a set of system activities, the purpose of which is to identify the possible failure site of the product (defect) and process, identify possible actions to eliminate or reduce the likelihood of their occurrence, and document all these activities in order to avoid serious consequences in particularly dangerous situations.

The analysis of the nature and consequences of refusal is carried out using the priority risk factor, which indicates which possible refusals are the most significant, and therefore which preventive measures should be taken first.

Scales have been developed to determine the value of coefficients: significance of consequences (SC), determination of causes (DC), occurrence of causes (OC).

Table 1. Scale for determining the value of the factor of significance of the consequences of technological hazards (SC)

The level of significance of the consequences of technological hazards	The essence of the consequences of technological threats	SC value
I	Technological risks can have some consequences.	0,1
II	A product whose minor impact on the quality indicators of the finished product does not go beyond the permissible values, is not felt for the consumer.	0,2-0,3
III	Average effect. Product quality indicators significantly exceed the maximum permissible values. Causes consumer dissatisfaction.	0,4-0,6
IV	Significant impact. Product quality indicators do not significantly meet the permissible limit values, but safety indicators comply with legal requirements. The discrepancy leads to the release of the consumer and a possible refusal to make a subsequent purchase.	0,7-0,8
V	A very important impression. Serious consequences, leading production has stopped.	0,9
VI	Critical. Safety indicators do not meet legal requirements - there is a risk to the life and health of consumers.	1,0

Table 2 - Technological hazard scale for determining the magnitude of the risk factor or its causes (DS)

Level of significance of the consequences of technological threats	The essence of the consequences of technological risks	Probability of finding	DS value
1	Very high. Emerging technological hazards or their causes are identified.	1 more	0,1
2	High. Emerging technological hazards it is very likely to identify risks or their causes, such as technological control or laboratory control.	Not more than 1	0,2-0,3
3	Evenly. It is possible to identify emerging technological risks or their causes: the ongoing technological control is relatively reliable.	Not more than 0,3	0,4-0,5
4	A little. Emerging technological hazards can identify risks or their causes: technological control is not reliable enough.	Not more than 0,2	0,6-0,7
5	Very small. Emerging technological risks it is very difficult to identify the risks or their causes: the technological control carried out is not effective.	Not more than 0,1	0,8-0,9
6	Close to zero. The risks of emerging technological hazards or their causes are not determined by existing methods and measuring instruments.	Not more than 0,01	1,0

Table 9. Technological risk scale for determining the value of the coefficient of occurrence of the causes of threats (OC)

Level of significance of the consequences of risks	The essence of the consequences of technological threats	OS value
A	The probability is close to zero.	0,1
B	Very little probability. The overall batch, technological risk corresponds to the previous statistics of technological control, in which a relatively small number of threats were observed.	0,2-0,3
C	Small probability. The batch corresponds to the previous statistics of control, in which a relatively small number of threats were observed.	0,4-0,6
D	Average probability. In general, the batch corresponds to the technological risk previous statistics of technological control, in which frequent occurrence of threats was observed.	0,7-0,8
E	High probability. The process is not stable. It is safe to say that technological risks arise in significant quantities.	0,9-1,0

3.2. Determining the need for measures to reduce significant technological risks

In order to determine the need for measures to reduce technological risks, a ranking Matrix was proposed for the level of occurrence of technological risks and the significance of the consequences in the production of semi-smoked sausages (Fig.2).

The ranking of technological risks is carried out at acceptable (low, medium and above-average risk) and unacceptable (high and unacceptable) levels [11].

The tolerance boundary reflects the level of planned occurrence and significance set by the expert group.

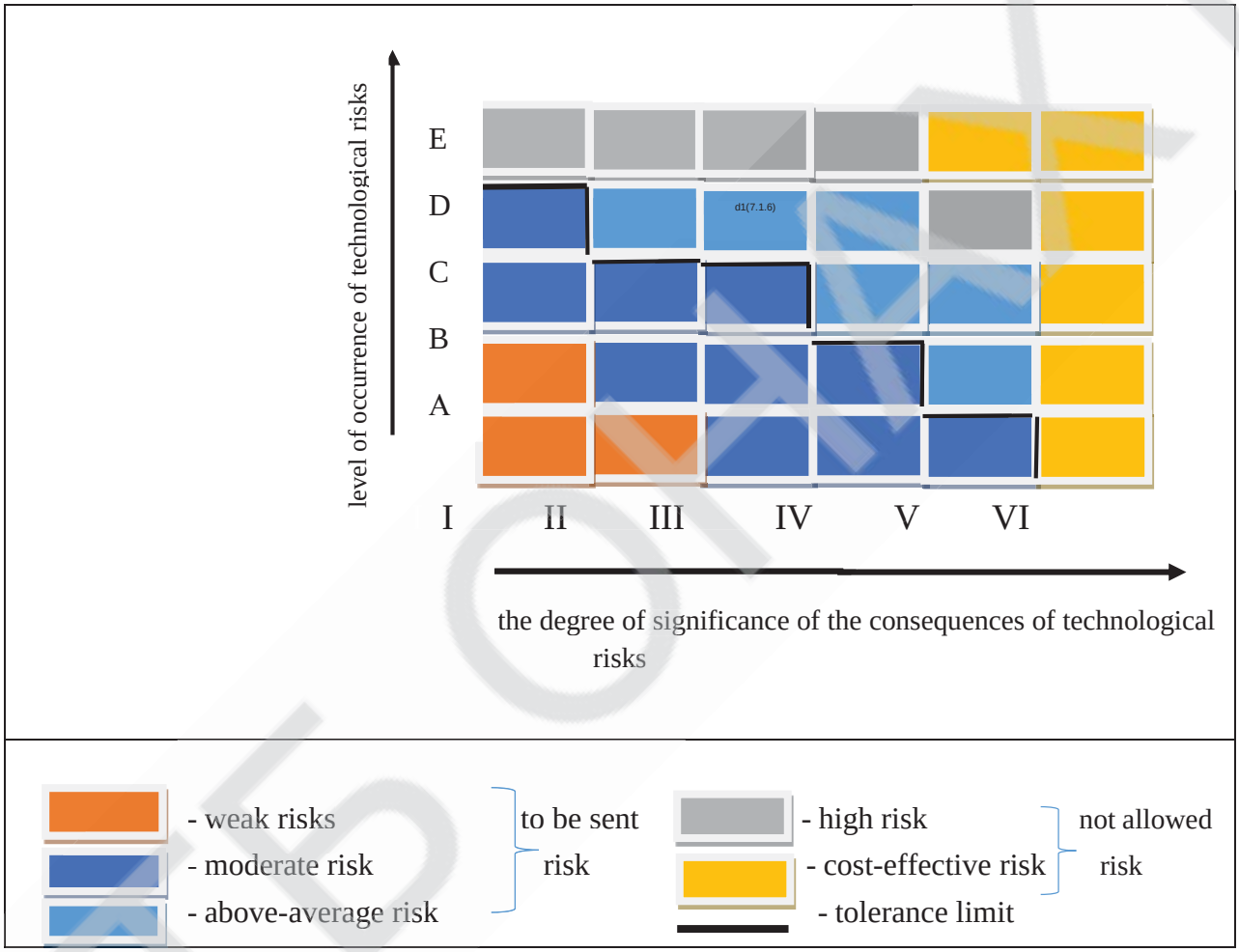

Figure 2. Technological risk ranking matrix

We have proposed to differentiate the technological risks. The production of semi-smoked sausages is allowed, which are separated by the limit of mutual tolerance.

In turn, acceptable risk threats are divided into: low, medium and high-risk threats. Unacceptable risks are divided into: high and unfavorable [12].

The expert team sets the location of the tolerance limit, which depends on the level of planned occurrence and the level of significance. Usually, the level of tolerance is defined as the greatest risk threats that a company is currently willing to bring.

Since technological risks are located above the line, it is necessary to quantify the risks and determine the most significant ones.

The analysis of the Risk Ranking Matrix confirmed the need to take the following measures to reduce technological hazards located above the permissible limit.

The objectives of technological risk management in food production are defined. Technological hazards, organizational forms of risk management, and system users are identified. Measures are planned to reduce the risks [13].

V. CONCLUSIONS

The procedure for identifying technological risks of food products using quality tools is scientifically justified, including: data collection, identification of the causes and consequences of technological risks, construction of a structural-parametric model for analyzing and predicting technological risk.

Scales were concluded for determining the significance of the consequences (SC), determining the cause (DC), and determining the origin of the causes (OC).

We have systematized possible defects in the production of semi-smoked sausages. The reasons that cause the risk of malfunctions in the production of semi-smoked sausages are identified.

Significant technological risks in the production of semi-smoked sausages are analyzed and a methodology for assessing technological risks is developed. We have developed an orderly chain of actions to identify, reduce, control and prevent technological hazards in the production of semi-smoked sausages.

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