

Assessment of the influence of technological factors on the risk of undeclared allergens in meat products

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Abstract. Since the use of warning labels for the possible content of allergens in products, unfortunately, cannot fully protect consumers suffering from food allergies, producers must effectively manage allergens in the production of meat products at the stages of traceability «from farm to table». In the course of this study, questionnaires were developed to assess the degree of influence of factors on the risk of allergens entering meat products at the traceability stages “from farm to table” based on the Delphi method and a qualimetric scale, with the help of which a survey was conducted among employees of meat processing enterprises of the Russian Federation. Based on the results of this study, the most common food allergens used in the meat industry of the Russian Federation were identified. The key factors at the critical stages of field-to-table traceability have been identified that have a strong impact on the possibility of realizing the risk of allergens in meat products at the farm-to-table traceability stages, which will help producers to focus on the most vulnerable stages when developing an allergen management system.

1 Introduction

Meat products may pose a food safety hazard to allergy sufferers if the labeling of these products contains incomplete or false information about the possible content of food allergens, or warning information is missing [1]. Thus, food allergens represent one of the most significant risks in the farm-to-table food safety traceability steps of meat production. Substances that cause allergies are mainly represented by proteins. They can often justifiably be added to meat products as ingredients, but there is a risk of food allergens being intentionally introduced into food allergen-free products as a result of cross-contamination [2].

In order to protect consumers suffering from food allergies, the legislation of many countries around the world has added a requirement to apply warning information about the presence of allergens on the labeling of food products, including meat. The lists of the most common components, the use of which can cause allergic reactions or is contraindicated in certain types of diseases, vary significantly in the legislation of different countries. However, all jurisdictions require that information about allergenic ingredients listed in the Priority Allergens List be required to be included in food products, regardless of the amount of allergens, or a warning about the possible content of allergenic ingredients in products must be included on product labels [3].

In the Russian Federation, the list of priority allergens is contained in the Technical Regulations of the

Customs Union «Food products in terms of their labeling» (TR CU 022/2012) and includes 15 positions:

- 1) peanuts and products of their processing;
- 2) aspartame and aspartame-acesulfame salt;
- 3) mustard and products of its processing;
- 4) sulfur dioxide and sulfites, if their total content is more than 10 milligrams per kilogram or 10 milligrams per liter in terms of sulfur dioxide;
- 5) cereals containing gluten and products of their processing;
- 6) sesame and products of its processing;
- 7) lupine and products of its processing;
- 8) shellfish and products of their processing;
- 9) milk and products of its processing (including lactose);
- 10) nuts and products of their processing;
- 11) crustaceans and products of their processing;
- 12) fish and products of its processing (except for fish gelatin used as a base in preparations containing vitamins and carotenoids);
- 13) celery and products of its processing;
- 14) soy and products of its processing;
- 15) eggs and products of their processing (Technical Regulations of the Customs Union «Food products in terms of their labeling» [4].

In the Russian Federation, there are the following warning labeling statements about the possible content of allergens: “they use ...”, “may contain ...”, “may contain traces of ...”, etc. An example of warning labels for the presence of allergens used in the Russian Federation is shown on the Figure 1.

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Fig. 1. Example of precautionary labelling of meat products for allergen content in Russian Federation

However, warning labels cannot fully protect consumers with food allergies. The increased incidence of inappropriate use of this type of warning label has reduced its impact as a risk reduction tool. This has led allergic consumers to distrust warning labels such as «may contain» and risk their health by consuming foods that may contain the allergen. For this reason, manufacturers must develop and implement an effective allergen management system within the facility that minimizes the risk of inadvertent exposure to allergens during farm-to-fork traceability «from farm to table» [5].

To date, many countries are developing regulatory documents that will help industry enterprises in managing allergens in the production of food, in particular meat, products. Thus, at the 43rd session of the Codex Alimentarius Commission on September 25, 2020, the Code of practice on food allergen management for food business operators (CXC 80-2020) was adopted. This Code of Practice provides guidance on the management of allergens in food production, including measures to prevent cross-contact, where an allergen is inadvertently transferred from food that contains the allergen to food that does not contain the allergen [6].

In the Russian Federation, at present, within the framework of the Technical committee for standardization 226 «Meat and meat products» on the basis of the V.M. Gorbатов Federal Research Center for Food Systems of Russian Academy of Sciences, a national standard GOST R “Meat industry. Order of development of allergen management program for meat industry” is being developed, which establishes the procedure for developing a food allergen management program, general requirements for the organization and implementation of the allergen management process, documenting the results of this activity and their analysis at meat industry enterprises.

In connection with the relevance of allergen management, we conducted a study aimed at assessing the degree of influence of factors on the risk of allergens in meat products at the traceability stages «from farm to table».

2 Materials and methods

This study consisted of four stages. At the first stage, questionnaires were developed to assess the degree of influence of factors on the risk of allergens entering meat products at the stages of traceability «from farm to table» based on the Delphi technique and a qualimetric scale to assess the importance of the influence of factors on the risk of allergens entering meat products.

The questionnaire included the following data:

- 1) The purpose of the survey (Determination of the degree of influence of factors on the risk of allergens in meat products);
- 2) Education of the expert taking the survey;
- 3) The length of service at the enterprise of the expert taking the survey;
- 4) Date and time of the survey;
- 5) Table with columns:

- Stages of the chain "from farm to table";

- Name of the reasons for the risk of allergens getting into meat products;

- Evaluation of the expert (according to the scale given at the end of the table);

- Note.

6) A qualimetric scale for assessing the importance of the influence of factors on the risk of allergens entering meat products to determine the expert's assessment, shown in Table 1.

The Delphi technique consists in an expert assessment of a group of people, but this assessment must be anonymous, in absentia and include several levels. This method was implemented in accordance to IEC 31010:2019 «Risk management - Risk assessment techniques», NEO.

At the second stage, a survey was conducted among employees of five meat processing enterprises located in various regions of the Russian Federation using the developed questionnaires. In total, 30 employees of 10 meat processing enterprises of the Russian Federation took part in the survey.

At the third stage, the data obtained during the survey were processed, the main factors for the ingress of allergens into meat products were systematized, those of them that had a greater effect on the risk of unintentional introduction of allergens into meat products were identified.

At the fourth stage, based on the data obtained during the survey, a cause-and-effect diagram (Ishikawa analysis (fishbone) method) was developed that clearly demonstrates the factors that affect the risk of allergens in meat products at the stages of traceability «from farm to table». The cause-and-effect diagram (Ishikawa analysis (fishbone) method) was developed in accordance to IEC 31010:2019 «Risk management - Risk assessment techniques», NEQ. The input data for its construction were the factors that affect the risk of undeclared allergens getting into meat products at different technological stages, named by experts during the survey.

3 Results and discussion

According to the results of the research, it was revealed that the most common allergens in the meat industry of the Russian Federation are milk, eggs, soybeans, mustard, peanuts, nuts, gluten, sesame, celery.

Table 1. Qualimetric scale for assessing the importance of the influence of factors on the risk of allergens in meat products.

Scale score	Chance of occurrence	Spacing
4	75-100 %	The factor has a strong influence on the risk of allergens getting into meat products
3	20-75 %	The factor has an average impact on the risk of allergens getting into meat products
2	5-20 %	The factor has little effect on the risk of allergens getting into meat products
1	0-5%	The factor does not affect the risk of allergens getting into meat products

Table 2. The most significant factors of allergens getting into meat products at the stages of traceability «from farm to table».

Stage	The factor that most strongly influences the realization of the risk of undeclared allergens
Animal keeping	Feed that animals have eaten, water if they contain allergens
Animal slaughter	Risk of cross-contamination during primary processing
Production of raw materials and auxiliary materials	The risk of contamination of raw materials and auxiliary materials during their production
Transportation of raw materials and auxiliary materials to the manufacturing plant	Compliance with the requirements of the commodity neighborhood during transportation
Purchase of raw materials, analysis of specifications during incoming inspection	Lack of supplier evaluation procedures; lack of information on the presence of allergens in the accompanying documentation; lack of information on the presence of allergens on the label; risk of contamination due to improper handling of damaged containers, boxes, bags with allergens

Table 2. Part two

Production planning	Joint storage and movement within the enterprise of allergen-containing ingredients and free from them non-use of a clear designation of zones for separating intermediate storage and movement; no physical barriers lack of equipment, special pallets, containers separately allocated for work with allergens; lack of control over the use of equipment designed to work with allergens; lack of identification of allergenic ingredients by labeling or color code; lack of clean-up procedures for spills or damaged allergen containers; lack of sequence in the manufacture of allergenic products after free from them; risk of migration of allergenic dust during processing; lack of control over the re-inclusion of the product in the process; lack of special clothing for personnel working with allergens, and its untimely change; ignorance of staff about allergens and allergen control; there is no control of product alterations; sanitation schedules are not drawn up; lack of instructions for washing equipment; lack of washing equipment immediately after the production of food products with allergens; lack of dedicated cleaning tools; the risk of not thoroughly washing equipment
Packaging and labeling	Risk of mislabeling products containing allergens that do not contain information about the presence of allergens
Reception at the distribution center	Misjudgment of compliance of labeling of allergen-containing products with legal requirements
Acceptance, storage and sale of products in a trading enterprise	Incorrect assessment of compliance of the labeling of allergen-containing products with legal requirements; risk of incorrect labeling, which does not contain information about the presence of allergens, when cutting and repackaging products; risk of mixing products that do not contain allergens and contain, when slicing, slicing and repackaging products; risk of cross-contamination in case of non-compliance with the requirements of the product neighborhood; human factor, lack of employee awareness of allergens when working at the slicing station

Using the developed questionnaire based on the Delphi method and the qualimetric scale presented in Table 1, employees of meat industry enterprises assessed the degree of influence of factors on the risk of allergens

entering meat products at the traceability stages «from farm to table».

The results of processing the survey results are presented in Table 2.

Based on the data obtained, a cause-and-effect diagram was developed, shown in Figure 2, with the help of which key factors were identified at the most important stages of traceability «from farm to table», which strongly affect the risk of allergens entering meat products at the stages of traceability «from farm to table».

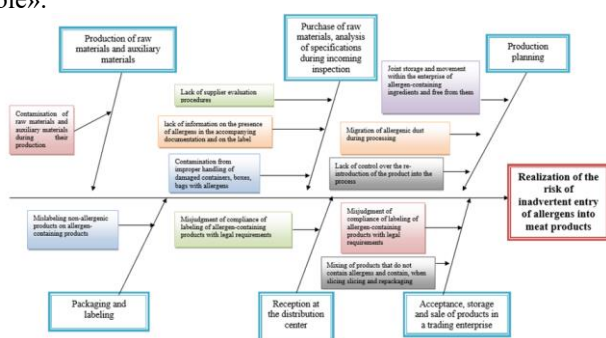


Fig. 2. Key factors at the most important stages of traceability «from farm to table»

Thus, it was found that the most significant factor at the stage of production of raw materials and auxiliary materials is the allergen contamination of raw materials and auxiliary materials during their production, at the stage of purchasing raw materials, analyzing specifications during incoming control - the lack of procedures for evaluating suppliers; lack of information about the presence of allergens in the accompanying documentation and on the label; contamination from improper handling of damaged containers, boxes, bags with allergens; at the stage of production planning - joint storage and movement of allergen-containing ingredients and free from them throughout the enterprise; migration of allergenic dust during processing; lack of control over the re-introduction of the product into the process; at the stage of packaging and labelling - applying incorrect labelling, which does not contain information about the presence of allergens, on allergen-containing products; at the stage of acceptance at the distribution center - an incorrect assessment of the compliance of the labelling of allergen-containing products with legal requirements; at the stage of acceptance, storage and sale of products in a trading enterprise - an incorrect assessment of the compliance of the labelling of allergen-containing products with legal requirements; the risk of mixing products that do not contain allergens and contain, when slicing, slicing and repackaging products.

4 Conclusion

Thus, it was found that the most common allergens at meat processing enterprises in the Russian Federation are milk, eggs, soybeans, mustard, peanuts, nuts, gluten, sesame, celery.

Based on the results of the analysis of the data obtained through the questionnaire, using a cause-and-effect diagram, it was found that the most significant

factor at the stage of production of raw materials and auxiliary materials is the allergen contamination of raw materials and auxiliary materials during their production, at the stage of purchasing raw materials, analyzing specifications during incoming control - the lack of procedures for evaluating suppliers; lack of information about the presence of allergens in the accompanying documentation and on the label; contamination from improper handling of damaged containers, boxes, bags with allergens; at the stage of production planning - joint storage and movement of allergen-containing ingredients and free from them throughout the enterprise; migration of allergenic dust during processing; lack of control over the re-introduction of the product into the process; at the stage of packaging and labelling - applying incorrect labelling, which does not contain information about the presence of allergens, on allergen-containing products; at the stage of acceptance at the distribution center - an incorrect assessment of the compliance of the labelling of allergen-containing products with legal requirements; at the stage of acceptance, storage and sale of products in a trading enterprise - an incorrect assessment of the compliance of the labelling of allergen-containing products with legal requirements; the risk of mixing products that do not contain allergens and contain, when slicing, slicing and repackaging products.

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