DEVELOPMENT OF INTEGRATED MODEL OF RISK ANALYSIS IN MEAT INDUSTRY

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Abstract: The existing global approach to risk analysis takes into account risks to human health and veterinary risks. However, this approach does not consider and does not evaluate the technological process of food production as a significant stage for the identification and management of risks. In relation to meat foods, it is the technological process, which will be a key factor in management decisions in the identification, assessment, management and communication of risks. The proposed integrated model of risk analysis reflects the peculiarities of meat products production all across the chain 'from field to consumer'. Described is the mechanism of implementation model with respect to chemical risks, because there are no stages to eliminate chemical risks in meat industry, and on the contrary, some stages contribute to the emergence and introduction of this type of risks (introduction of sodium nitrite, smoking, etc.). Focused is the peculiarity of identification, assessment, management and communication of chemical risks at the stages of the 'raw meat - processing – ready-to-eat product' process. An approach to scientifically based risk communication procedure for the Russian Federation is suggested. The use of the proposed model will improve confidence of producers, government agencies, and consumers in product safety both in respect with human health and veterinarian matters. This mechanism can be used as the legislative basis in the field of food production development, both for the Russian Federation and the Eurasian Economic Union.

Keywords: risk, risk analysis, risk assessment, risk management, risk communication, meat industry

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INTRODUCTION

The priority of food legislation in most countries of the world is the concept of risk analysis, which is seen as a key mechanism for the strategy development determining the focused action aimed at maximum, economically viable reducing the negative impact of chemical, biological and physical hazards to health. The member states of the Eurasian Economic Union are also guided by the global trend to introduce a risk-based approach to building and implementing a supranational food and veterinary legislation [1, 2].

Foodborne diseases are a real and serious problem. About one third of the population of developed countries suffer from diseases associated with the consumption of food. The main causes of these diseases are microorganisms and chemicals. Moreover, chemicals can cause both acute poisonings and chronic ones providing significant harm to human life and health, including those in subsequent generations. New technologies such as genetic modification and nanotechnology put forward additional food safety issues that require evaluation and management, as well as the relevant information about risks [2].

As to the products of animal origin, not only the risk of harm to human health, but also veterinary risks should be considered. Agreements on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) of the World Trade Organization (WTO) allow WTO members to install two versions of sanitary measures to protect against such risks. The established policies and regulations or more stringent requirements are adopted by the WTO with respect to the member states only on the condition that, the country will substantiate and prove this need by means of risk analysis. SPS Agreement urges the member states to base their sanitary and veterinary regulations on international standards, such as the World Organization for Animal Health (OIE) Terrestrial Animal Health Code and the documents of the Codex Alimentarius Commission, with the guidance documents on risk analysis [3, 4].

Meat and meat products occupy a leading position in the national diet. In 2014, the average consumption in the Russian Federation amounted up to 74 kg/year per capita [5].

In terms of security, meat and meat products should be considered not only as products, which if inappropriately processed can cause harm to human health, but also as potentially unsafe products in the veterinary regard. Meat products are known to be a source of proliferation because of a number of zoonotic diseases.

In world practice, meat products are considered as high-risk products, which are characterized by both biological and chemical hazards. The documents of the Codex Alimentarius and the OIE contain instructions for the use of the risk-oriented approach to products of animal origin. However, in the Codex Alimentarius they relate to a finished product and are considered with regard to human health and in the documents of the OIE, for the most part, – to the veterinary well-being of farm animals. Technological component is not highlighted in these documents, but it is this component which serves as an essential mechanism for managing both individual risks and their totality, which results in obtaining of a guaranteed security product within the expiration date, and security both in terms of human health, as well as with respect to its epizootic status .

In connection with this, the most important way to prevent alimentary human and animal diseases is the development of comprehensive risk analysis techniques specific to meat products in order to build, according to the analysis, the system of norm-setting, monitoring, production and state control of food products.

OBJECTS AND METHODS OF RESEARCH

As a research object, chemical risk analysis process was chosen, specific to meat industry.

The research was based on the system-modular approach to risk analysis.

RESULTS AND DISCUSSION

After analyzing the existing guiding documents, as well as identifying the missing link, which reflects the specificity of the meat industry we compiled the integration scheme of risk analysis approaches (Fig. 1).

The scheme is based on the FAO/WHO guidelines for assessing risk to health, as reflected in the documents of the Codex Alimentarius Commission and the OIE approaches. The proposed third block "technological risk analysis" includes the emphasis on the technological aspects of risk detection, identification, evaluation, management and communication. Moreover, "production technology" in this model is seen as a chain "from field to counter", including, in particular, the evaluation of raw material sources.

In explication of the proposed scheme (Fig. 2) it can be seen that the addition of "technological risk analysis" block allows you to combine different recommendations for risk analysis and create a holistic approach, reflecting the specificity of meat products. Thus, the OIE approach underlies in the risk analysis of raw animal material, and the approach of the Codex Alimentarius – the finished product. For all that, the relationship can be traced to the information received at the stages of risk assessment on the OIE and the Codex Alimentarius, which underlies in the information used in the assessment of technological risk. In turn, the information obtained during the "risk management' stage in the 'technological risk analysis" block is the source of initial information for similar stages by the OIE and the Codex Alimentarius.

The unifying element of the whole scheme is the stage of risk communication, which provides the exchange of information between all the components of the line, at the same time correcting and correlating the results with each other, thus creating an effective tool for an integrated approach to risk analysis for meat products.

Provided that the management of chemical risks in the line of meat production is rather difficult, since there are no processing stages, allowing to reduce this hazard, the proposed model was examined on this form of risk too [7, 8].

The first "hazard identification" stage for chemical risks means the identification of a chemical element contained or allegedly contained in ready-to-eat meat products. For the identified element the analysis of available information on the possibility of its adverse effect on human health is performed.

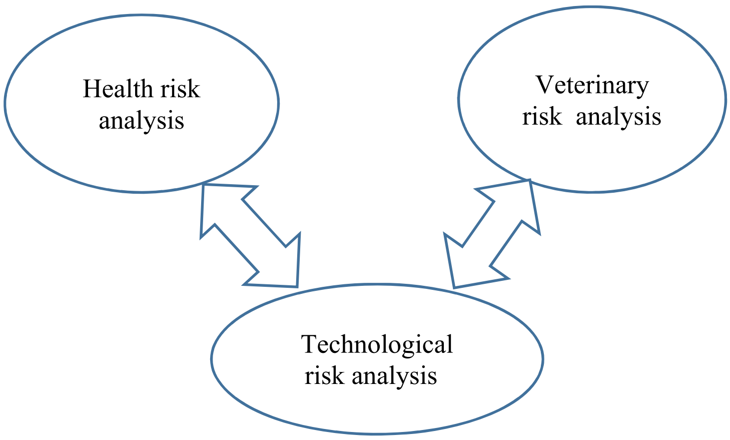

Fig. 1. Integration scheme of risk analysis approaches for meat products.

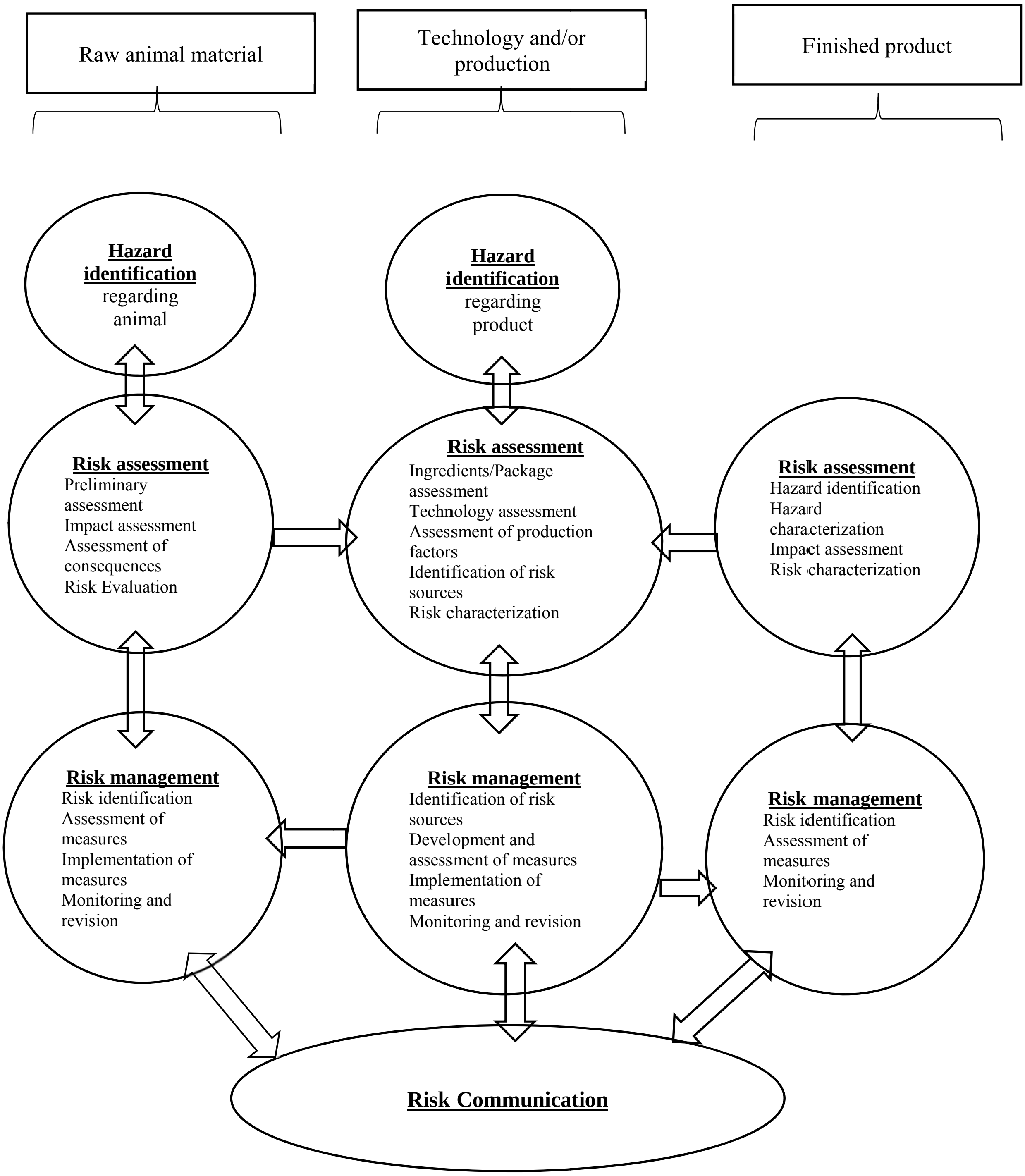

Fig. 2. Integrated model of risk assessment in meat industry.

The peculiarity of the use of this stage in relation to meat products is to identify not only the elements that directly have an adverse effect on human health, but also to identify the elements that contribute to the displacement of alimentary equilibrium of micro-, makronutrients entering the body. Besides it is necessary to consider substances – precursors of chemical compounds capable to form dangerous chemical complexes to health when processed or stored.

The second “risk assessment” stage consists of several substages. At the beginning “hazard description” is formulated, then the nature of an organic / inorganic chemical element, its environmental stability, prevalence, reactivity, etc. are examined. In particular, at this stage the known data on the dependence of adverse health effects from the doses of the substance are described. From the point of view of the technological component assessment it is necessary to identify the critical substages appropriate to the composition of raw materials, packaging technology of the product in respect to the estimated risk (introduction of nitrite, food additives, smoking, etc.).

In the analysis of information at the "identification of risk sources" substage (Fig. 3) the entire food chain "from field to counter" is considered to identify the chain stages in which chemical element in question falls into. Moreover it is important to remember that the first stage, in the case of analysis for meat products, is the information about the conditions of fodder cultivation. It is this stage that is one of the main sources of chemical risks entering the food chain. Equally important is the information on the epizootic status of region's livestock breeding and the degree of environmental pollution (with the identification of major pollutants), since it can serve as the information on the probability of inclusion of veterinary drugs and natural / man-made contaminants into the food chain.

Identification of risk sources, Analysis of food chain stages "from field to counter", Fodder cultivation region, Livestock breeding region, Lifestock processing technology, Product obtaining technology, Life and storage conditions.

At the technological stage of this analysis block the specific product and formulated risk are considered. Basically here attention is drawn to the commercially used chemicals which do not take part in the process of production directly (lubricants for equipment, detergents and disinfectants, chemicals for refrigeration units, boilers, veterinary or merchandising dyes, etc.).

Also are identified constituent components of the product which are characterized by the content of the chemical element (by-products, bones, fat, and other ingredients). Besides at this point packing is regarded as the source of chemical elements migrating into the product. Defined are technological stages and the conditions under which dangerous chemicals are formed.

At the "impact assessment" substage the determination of the product consumption level in the overall diet of the average consumer is carried out, and other products containing the chemical element in question are also identified.

"Risk characterisation" substage is the final in the "risk assessment" stage, and includes the analysis of the information obtained in previous substages and drawing up the risk profile.

Risk management, Preliminary risk management activities, Generation of control measures, Implementation (introduction) of control measures, Monitoring and assessment

"Risk management" stage (Fig. 4) is divided into several substages.

In the first substage setting a goal on analyzed risk management with respect to the reported chemical elements and generating of information on the existing control mechanisms are carried out, the analysis of their effectiveness (if possible) is also performed.

Next, control actions are formulated, the effectiveness of which is supposed to be sufficient to achieve the objective of risk management under consideration. Moreover alternative measures are identified, for their efficient use in the case of the ineffectiveness of the main events.

When forming the control measures, the assessment of cost-effectiveness correlation to use the event should be an important component, because in the case of too high costs for the event the effectiveness of its implementation is significantly reduced.

The implementation activities include the development or bringing in the changes to existing regulations, technical and regulatory documents, planning of monitoring studies and so forth.

At the next stage system monitoring and evaluating the effectiveness of control measures are carried out.

Risk communication, Scientific communication, Traceability, Emergency information.

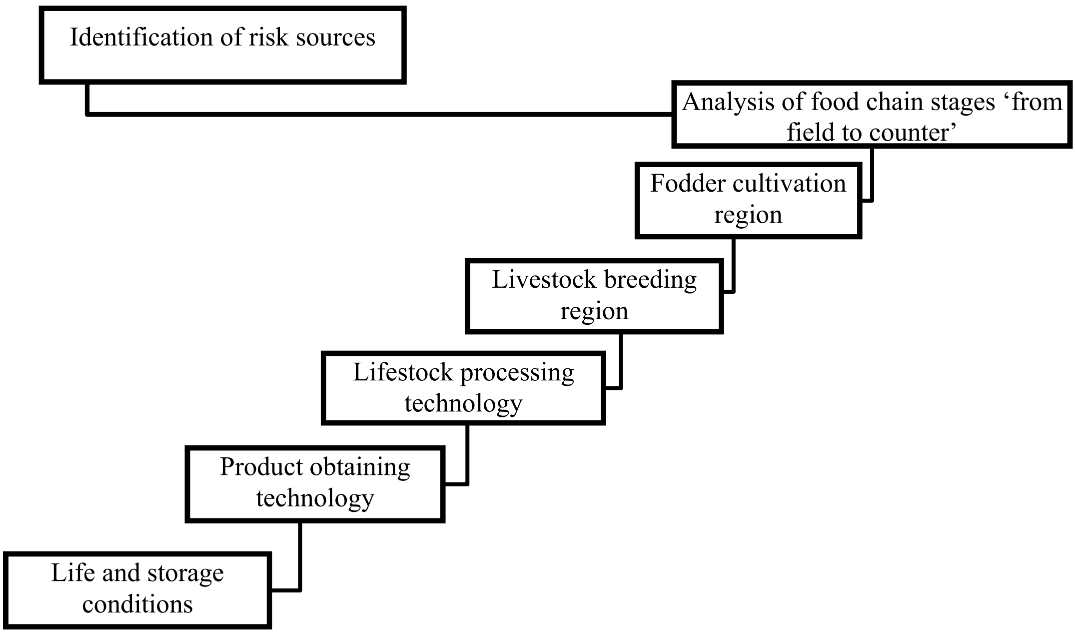

Fig. 3. Model of the "Identification of risk sources" stage.

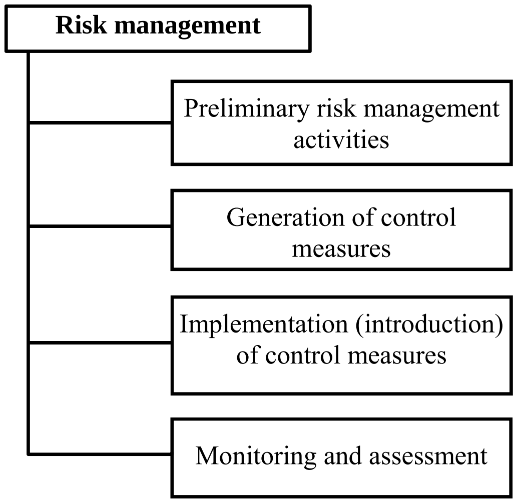

Fig. 4. Model of the "risk management" stage.

At "Risk communication" stage (Fig. 5), it is important to identify the stakeholders to obtain information about the risk, as well as the way of bringing this information to the notice.

Scientific communication is a key factor in the most effective risk analysis as it involves multidirectional research teams for a comprehensive study and obtaining of information about the risks. For meat production, science communication should take place between technological institutes, hygiene institutes in the field of public nutrition, and veterinary institutions. The principle of cooperation between instititutions is presented in Fig. 6.

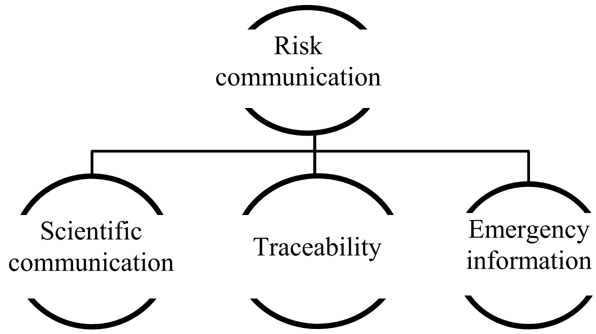

Fig. 5. Model of the "Risk communication" stage.

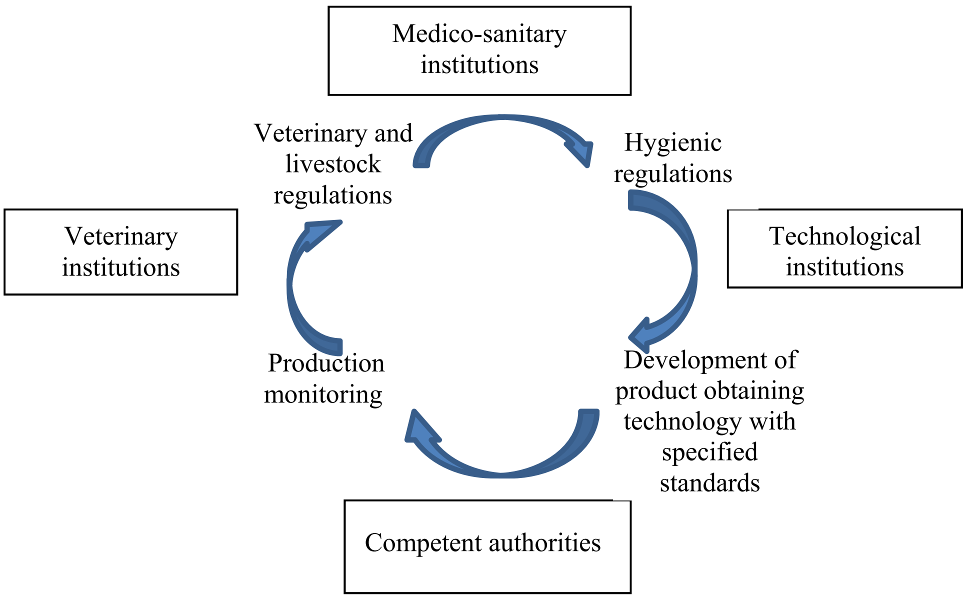

Fig. 6. Principle of scientific communication in the Russian Federation.

Veterinary and livestock regulations, Hygienic regulations, Development of product obtaining technology with specified standards, Production monitoring.

The next important substage in risk communication is the system of traceability. Obtaining objective information about any part of the food chain one can effectively monitor the status of chemical safety of the product in due course to identify the causes of certain excess chemical elements and to take corrective and preventive actions in time.

This approach has shown high efficiency in many countries, and is now the mandatory legislative requirement in most developed and developing countries, including the Russian Federation.

Development of an emergency notification system promotes coordinated work of all federal agencies in case of a threat to the population as a consequence of food consumption. This system is also based on the traceability system and is a well-proven mechanism in many countries around the world.

When carrying out the risk analysis, such factor as consumer behavior must be taken into account too, because under the influence of various social reasons typical consumption diet can vary, or separate consumer groups (vegetarianism, religious rejection of certain products, the transition to low cost products, etc.) may be formed. It can lead to the distortion of information at the stage of evaluation and risk specification.

An important influencing factor is also the establishment of standards at different levels: national, interstate, and international ones. In some cases, the established hygienic norms may differ, which also must be considered when evaluating staple food components.

CONCLUSION

The developed model allows to give full consideration of the risks specific to meat products and to establish effective management mechanisms both at the production and at the state level.

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