

## FEATURES DEFINITIONS OF PERFORMANCE MANAGEMENT SYSTEM IMPLEMENTATION OF THE QUALITY AND SAFETY OF FOOD PRODUCTS TO THE ENTERPRISE

Elena N. Halturina<sup>1\*</sup>, Svetlana G. Kreneva<sup>2</sup>, Guzal R. Tsareva<sup>3</sup>,  
Vilena B. Yelagina<sup>4</sup> and Vlada V. Tereshina<sup>5</sup>

<sup>1</sup>Asst. Prof., Mari State University, Russia, Le\_Xa@list.ru

<sup>2</sup>Asst. Prof., Mari State University, Russia, kreneva.sv@yandex.ru

<sup>3</sup>Asst. Prof., Volga State University of Technology, Russia, tsarevagr@volgatech.net

<sup>4</sup>Asst. Prof., Volga State University of Technology, Russia, Elaginavb@volgatech.net

<sup>5</sup>Asst. Prof., Volga State University of Technology, Russia, TereshinaVV@volgatech.net

\*Corresponding author

### Abstract

Currently, the HACCP (Hazard Analysis and Critical Control Points) system is the basic model of the control and regulation of food product quality the main instrument to ensure its security. HACCP is a system of safety management of food which provides control over absolutely all stages of the food chain at any point in the production process as well as the storage and sale of products where there is a possibility of a dangerous situation. HACCP system is mainly used by manufacturers of food products.

Particular attention is paid to the so-called critical control points, in which all existing types of risks associated with the use of food as a result of targeted control measures can be prudently prevented, removed and reduced to a reasonably acceptable level.

The article describes the theoretical and methodological approaches to test the effectiveness of quality management system in the food industry in Russia. In developed countries each manufacturer develops its own HACCP system which takes into account all the technological features of production. The developed system can be changed, processed in order to meet any changes in manufacturing technology processes. In our study we provide an assessment of the effective implementation of the quality management system based on HACCP principles in the LLC "Bakery №1» Mari El Republic. Identified critical control points in the production of bakery and confectionery products. The order of carrying out verification of compliance with regulatory requirements of the enterprise to ensure the safety of food products, which includes the subject of verification of compliance with the requirements of TR CU 021/2011, TR CU 022/2011, 005/2011 and TR CU technical regulations of the Customs Union for certain types of food products and requirements established by Russian legislation.

**Keywords:** principles of HACCP quality system, product safety, performance evaluation methodology, monitoring the critical points.

## **1. INTRODUCTION**

Technical Regulations of the CU 021/2011 "On food safety" acts since 2011. Entering into force TR CU 021/2011 has made the implementation of the HACCP system in the food industry statutory.

In accordance with the decision of the Commission of the Customs Union (number 880 of 09/12/2014) until February 15, 2015 was a transitional period. During the transitional period it is allowed the production and putting into circulation of the product in accordance with the mandatory requirements previously established by normative legal acts of the Customs Union or the law of the State - a member of the Customs Union, if there are documents on evaluation (confirmation) of conformity specified mandatory requirements issued or made until the day of the Technical regulations coming into force.

On February 15, 2015 any enterprise engaged in the production of food is required to have a HACCP plan developed. Otherwise, the manufacturer may be a subject to administrative liability in accordance with Article 14.43 of the Administrative Code "Violation of the manufacturer, the executor (the person performing the functions of the foreign manufacturer), manufacturer of technical regulations."

HACCP system is a set of organizational structures, documents, processes and resources needed to implement quality management system based on HACCP principles.

HACCP system should be developed taking into account the seven basic principles:

1. Identification of potential risk or risks (hazards) that are associated with the production of food products, from receipt of raw materials to the final consumer including all stages of the product life cycle in order to identify the emergence of potential risk conditions (risks) and to establish the necessary measures for their control;
2. Identification of critical control points in production to eliminate (minimize) the risk or the possibility of its occurrence, while the transactions in food production can cover the supply of raw materials, selection of ingredients, processing, transportation, storage and sale;
3. In the documents of the HACCP system or process instructions to install and to respect the values of the parameters to confirm that the critical control point is under control;
4. Development of a monitoring system that allows you to maintain control of critical control points on the basis of planned measures or observation;
5. Development of corrective actions and their application in the case of negative results of the monitoring;
6. The development of verification procedures which should be regularly carried out to ensure the effectiveness of the HACCP system functioning;
7. System documentation of all procedures, forms and methods of registration data related to HACCP system.

In accordance with applicable law personal responsibility for the safety of products is covered by the management of the organization. The company's management must define and document a policy regarding the safety of products and to ensure its implementation and support at all levels.

Security policy must be practicable and feasible, comply with the requirements of bodies of state control and supervision and the expectations of consumers.

The organization's management must define the distribution area of the HACCP system for certain types (groups or names) of products and stages of the life cycle which include production, storage, transportation, wholesale and retail sale and consumption including the catering.

## **2. OPINION AND DISCUSSION**

In modern conditions the product manufacturers understand that the way of their survival and well-being in the market environment - is the creation of high quality products, competitive both in the domestic and foreign markets.

LLC "Bakery №1» since its start-up is a major supplier of bakery and confectionery in the city Yoshkar-Ola, Mari El Republic and the neighboring regions.

The fundamental principle of the enterprise - the traditional quality and a wide range to satisfy the diversified needs of consumers. The main purposes of the plant are:

- product safety is a priority goal of the enterprise;
- development and production of bakery and confectionery products best meet the needs of consumers at the expense of consistently high quality and safety of products;
- a harmonious combination of taste properties and nutritional value of products;
- market expansion.

This objects are achieved by:

- continuous improvement of qualitative characteristics of bakery and confectionery products;
- formation of the assortment policy of the enterprise taking into account the development of new competitive varieties of confectionery products;

- permanent market research;
- reliable delivery of the required product quality;
- introduction of advanced production technology and advanced equipment;
- continuous training of staff including in the field of quality;
- development, implementation of technological instructions, recipes, compliance with which is at the proper level will prevent the problem of quality in the production units;
- control of technological discipline by establishing preventative maintenance system, TBO;
- organization of the metrological verification of measuring instruments and control;
- formation in the field of quality assurance goals and objectives for each department, their employees and provide explanations on the part of the conditions for their implementation guide.

To solve this problem employees of the company study the experience of the best domestic and foreign enterprises, introduction of similar developments, visiting exhibitions, study of special printed products. In drawing up the new technical reconstruction of production projects the introduction of new technologies, new varieties of products is taken into account the experience of the best of the food industry.

Taking into account that the protection of human health is of paramount importance the immediate task of the whole team is:

- the development, certification and maintenance of the quality system based on the principles of HACCP (Hazard Analysis and Critical Control Points);
- the most comprehensive consideration of the interests of clients, a manifestation of loyalty to them, an alacrity to compromise is a basic principle of our company.

Management of №1 Bread Factory is committed to and responsible for the conduct of the Quality Policy and takes all necessary steps to ensure its employees understand the entire enterprise team.

On production there is a need to develop and implement an effective quality system that ensures the release of safe and high quality products.

The most modern warning system that ensures the quality and safety of food products being introduced today in the food industry is a system based on the principles of HACCP (Hazard Analysis and Critical Control Points). The quality system based on HACCP principles allows to combine the analysis of the monitoring and control of production established in the company with the current resolution of the European Parliament and of the Council №852 / 2004 from 20.04.04 (requires manufacturers to perform risk analyzes, revealing in the process parameters is crucial for ensure product safety and conduct appropriate activities (monitoring) in certain critical points of the process), the general hygiene requirements for all food business operators.

Based on the policy of the company's management in the field of quality and safety of products, maintenance of the quality management system and the safety of products on the basis of the principles of HACCP (Hazard Analysis and Critical Control Points a permanent working group of HACCP) was organized in the company in 2014.

An important component of leadership in the quality of the HACCP system is the correct identification of critical control points (CCPs). Imagine selection algorithm and classification management activities by sequential analysis process operations (Fig. 1).

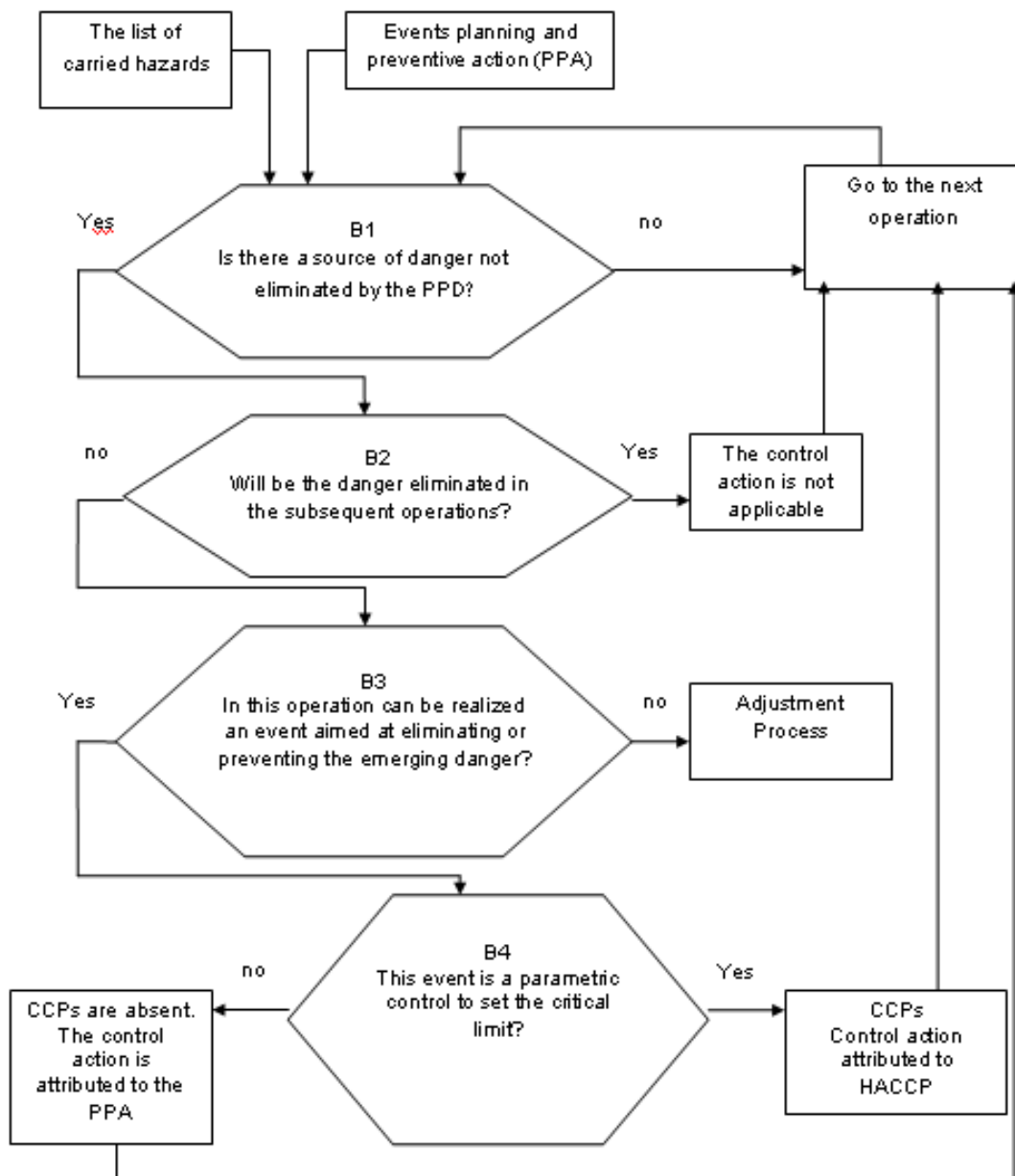


Fig.1. The algorithm for determining of the critical control points (CCPs) in production processes.

In the analyzed company there is represented the association of the critical control points identified in the analysis of the input control of raw materials, manufacturing processes of semi-finished and finished products (carried out in cases where the critical control points are controlled by one person or belong to a single operation), Table 1.

Table 1. Association of Critical Control Points (CCPs)

No CCPs	Designation of critical control point	Performed CCPs monitoring	Production area
1.	meal test for infection potato sticks	Process Engineer	Control Production Laboratory
2.	Input raw material quality control according to test results the bacterial laboratory	bacteriologist	Bacterial laboratory
3.	Input raw material quality control on the absence of contamination, pest infestation	Process Engineer	Control Production Laboratory
4.	Controlling the content of solids in the syrup while boiling dried fruits	technological change	Confectionery, laboratory

5.	Control of temperature and time of roasting nuts	technological change	Confectionery, wardrobe SHPESM
6.	Control of temperature and baking time of semi-finished and finished products	technological change	Confectionery, bakery department (2 rotary furnace, the furnace 1 EMB -90/053)
7.	Control of temperature and humidity syrup for confectionery production	technological change	Confectionery, Production Laboratory
8.	Control of food additives in making semifinished	technological change	Confectionery, Production Laboratory
9.	Control of temperature and baking time of bread and bakery products	technological change	Bakery shop (3 furnace CPA-40, 2-oven 25 PHS, PHS 1 oven-25M rotary kiln)
10.	Control of temperature and time of drying crackers, toast	technological change	Bakery shop, the production site of crackers, toast
11.	Control making improvers in bread and bakery products	Process Engineer	Bakery shop
12.	Control of temperature and baking time of bread and bakery products	technological change	Breadcrumbs-Doughnuts shop (rotary kiln)
13.	Control of temperature and time of baking Doughnuts and rusks	technological change	Breadcrumbs-Doughnuts shop (PHS-25M)
14.	Control of temperature and time of baking cookies	technological change	Breadcrumbs-Doughnuts shop (A2 SHPE line)
15.	Control of temperature and time of roasting semi-finished product in the production of "Chak-chak"	technological change	Breadcrumbs-Doughnuts shop production site "Chuck-Chuck" (deep fryer)
16.	Control of solids content in honey and sugar syrup in the production of "Chak-chak"	technological change	Breadcrumbs-Doughnuts shop Production Laboratory
17.	Monitoring application of food additives in the production of finished products	technological change	Breadcrumbs-Doughnuts shop Production Laboratory
18.	Monitoring application of food additives in the production of finished products	technological change	Confectionery, Production Laboratory
19.	Acceptance control of the absence of potato disease of bread and bakery products	Process Engineer	Control Production Laboratory
20.	The microbiological control of the finished product by company's bacterial laboratory	bacteriologist	Bacterial laboratory
21.	Control of products based on the results of periodic testing in accredited test laboratories	Process Engineer	Control Production Laboratory

After the implementation of HACCP in 2014, LLC "Bakery №1» product quality improvement, quality control has become more detailed, but there were some flaws.

Therefore, it is advisable to assess the risk of release of hazardous products in order to determine the category of enterprise risk degree.

The examination includes. (Methodological approaches to evaluation of production processes (manufacturing) of food products based on HACCP principles,2014):

a) check whether the underlying documents confirming the development of procedures based on HACCP principles in the management system in accordance with Article 10 TP TC 021/2011: policy and / or documented statements of intentions on safety management of food production, security management (voluntarily); organizational structure (with an indication of the structural units, their subordination and interaction); developed and documented procedures based on HACCP principles in the management system including production control program; regulations governing the safety of products.

- b) assessment of the safety of products to conduct sampling and laboratory testing on the basis of an accredited (independent) laboratories for the purpose of conformity of production of regulatory documents and confirm the effectiveness of the management system. In order to ensure the objectivity of the results it should be used rules and research (testing) and measurement methods including sampling rules required for application and implementation of adopted technical regulations and the implementation of conformity assessment, the list of which is defined in a particular decision of the Customs Union Commission, has approved the technical regulations Customs Union to a particular type of product.
- c) check the implementation and maintenance of procedures based on HACCP principles including the program of production control;
- d) an analysis of the submitted documents for compliance with the requirements of TR CU 021/2011, TR CU 022/2011, 005/2011 and TR CU technical regulations of the Customs Union for certain types of food products and the requirements established by Russian law;
- e) an assessment of the exchange of information with stakeholders in the organization and outside;
- f) checking for validation of the developed procedures, verification and continuous improvement of management system.
- g) the object of examination.
- h) assessment of the risk of release of hazardous products in order to determine the administrative measures and the choice of priority projects supervision.
- i) checking the existence and evaluation of regulatory documents in the enterprise, their actualization, the definition of the priority of normative documents which are the basis of management systems implemented in the company. The form and volume of the documents which confirm the existence and functioning of procedures determined by the enterprise independently;
- g) To assess the functioning of the safety management system based on HACCP principles and procedures regulated by the requirements of Article 10 Part 3, Article 11 part 3, part 4 TR CU 021/2011, documented and visually during the examination of the object.

Each treatment should be evaluated for the presence of hazards, their identification, analysis followed by the inclusion of HACCP documents. In case of the lack of developed and implemented in the company procedures based on HACCP principles in the management system in accordance with paragraph 2 of Article 10 TP TC 021/2011, the company is an enterprise with critical or unacceptable risks (category 4 or 5) in the first stage check. So, enterprises need to develop corrective measures on almost all procedures.

To assess compliance with food safety there are used and analyzed statistical and reporting results of a database of previous audits. In order to assess the risk of release of hazardous products there are necessary:

- To determine the weighting procedures and dangers of the other test subjects (presence management systems, its support);
- On a scale to assess the compliance procedures and other objects inspection requirements of TR CU 021/2011. (TR CU 021/2011 Technical Regulations of the Customs Union "On food safety" approved by the decision of the Customs Union on 09.12.2011).

Each treatment should be evaluated for the presence of hazards, their identification, analysis followed by the inclusion of HACCP documents.

The weight coefficient of hazard procedures and other checking items may vary depending on the characteristics of the industry and the manufacture of the product technology.

The weight coefficient of hazard procedures and other checking items is determined by an expert according to the formula. (Methodological approaches to evaluation of production processes (manufacturing) of food products based on HACCP principles, 2014):

$$\sum_{j=1}^n K_j = 1 \quad (1)$$

Where:

- $j$  the serial number or verification procedures for the subject;
- $n$  the number of procedures and test items identified in the score sheet;
- $K_j$  hazard ratio weighting procedure or test subject.

The calculated weight factors of danger processes by type of business can vary as well depending on the characteristics of the region (development of food industries, sanitary and epidemiological situation), Table 2.

Table 2. The weights hazard procedures and food processors test subjects

No	Name and verification subject	The weighting factor of danger of the food industry
1	Availability of documents confirming the development of procedures based on HACCP principles (the presence of the developed management systems) and the assessment of product safety	0,25
2	procedure 1	0,04
3	procedure 2	0,04
4	procedure 3	0,01
5	procedure 4	0,1
6	procedure 5	0,09
7	procedure 6	0,03
8	procedure 7	0,09
9	procedure 8	0,1
10	procedure 9	0,08
11	procedure 10	0,01
12	procedure 11	0,04
13	procedure 12	0,02
14	The principles of HACCP	0,09
15	Support and improvement of procedures based on HACCP principles (Management Systems)	0,01
	TOTAL	1

Compliance procedure or test subject is assessed by a scale from 0 to 1. In the case of full compliance with each procedure is assigned a score of 1 while minor discrepancies in terms of the risk of release of hazardous products - 0.5 points, with a significant mismatch - 0 points. (Tsareva, 2016).

This information concerning LLC "Bakery №1» is recorded in the score sheet for the form, Table 3.

The evaluation sheet is based on the results of audit. The sheet contains information about the point of conformity assessment procedures and test items, calculation is carried out using a weight ratio of danger according to the formula:

$$\sum_{j=1}^n k_j \cdot q_j \cdot 100 \quad (2)$$

Where:

- $j$  the serial number of procedures
- $k_j$  hazard ratio weighting procedures
- $q_i$  Scoping compliance procedures,  $q_i = 0-1$ ;

Table 3. Evaluation sheet for the results of the audit on the Company "Bakery №1»

No	Name and verification subject	The weight ratio of the procedure and checking the object *	Compliance, (1 point)	Minor discrepancies (0,5 points)	Significant non-compliance (0 points)	Conformity assessment (%)
1.	Availability of documents confirming the development of procedures based on HACCP principles (article 10, part 2)	0,25	1	-	-	25
2.	Procedure 1 (article 10, par t1, paragraph 3)	0,04	1	-	-	4
3.	Procedure 2 (article 10, part 2, paragraph 3)	0,04	1	-	-	4

4.	Procedure 3 (article 10, part 3, paragraph 3)	0,01	1	-	-	1
5.	Procedure 4 (article 10, part 3, paragraph 4)	0,1	-	0,5	-	5
6.	Procedure 5 (article 10 part 3, paragraph 5)	0,09	1	-	-	9
7.	Procedure 6 (article 10 part 3, paragraph 6)	0,03	1	-	-	3
8.	Procedure 7 (article 10 part 3, paragraph 7)	0,09	1	-	-	9
9.	Procedure 8 (article 10 part 3, paragraph 8)	0,1	1	-	-	10
10.	Procedure 9 (article 10 part 3, paragraph 9)	0,08	1	-	-	8
11.	Procedure 10 (article 10, part 3, paragraph 10)	0,01	1	-	-	1
12.	11 Procedure (article 10 part 3, paragraph 11)	0,04	1	-	-	4
13.	12 Procedure (article 10 part 3, paragraph 12)	0,02	-	0,5	-	1
14.	HACCP principles (article 11, part 3, paragraph 4)	0,09	-	0,5	-	4,5
15.	Support and improvement of procedures based on HACCP principles (Management Systems) (article 10, part 2)	0,01	-	0,5	-	0,5
	In total	1				89

As a result of evaluation of the enterprise scorecards holding companies ranking and define the risk of release of hazardous products. Depending on the risk ranking there is recommendation to range companies in five categories, Table 4.

Table 4. Characteristics of the enterprises according to the degree of risk

Category	The results of the conformity assessment%	Degree of risk	Enterprise features
category 1	95 - 100	The risk of minor	Stable operating company for which is recommended to maintain and further improve the management system
category 2	91 - 94	The risk of a valid	The company in which is unlikely to occur hazards; It requires the development of corrective actions
category 3	81 - 90	The risk of a significant	The company which requires the development of corrective action for several procedures
category 4	71 - 80	The risk of an unacceptable	The company which requires the development of corrective actions in almost all procedures
category 5	70 or less	The risk of a critical	The company which requires the development, implementation and updating of management systems up to the suspension of activities of the enterprise

After the analysis of risk degrees it is found that LLC "Bakery №1» refers to enterprises category 3, i.e., the company which requires the development of corrective action for several procedures.

From the scorecard it is obvious the company is not at a sufficient level established monitoring procedure for food raw materials, technological means, packing materials, products used in the manufacture of food products. This leads to the fact that the company has a percentage of product recalls due to the presence of foreign elements in the package or in the product itself. It is necessary to ensure complete output control as well as to tighten control over the raw material used in the process of production. (Shakirov, & Shakirov, 2013).

Also there are inaccuracies in the traceability process. The company needs to define the unit of traceability. Production volume released during the week may be defined as the unit of traceability. The system may be ineffective and useless in case of wrong choice of traceability units.



### **3. CONCLUSION**

To meet the objectives of a traceability system the company needs to determine what information should be:

- received from their suppliers;
- collected about the product and the history of the production process;
- provided for customers and / or suppliers.

Activity aimed at improvement should be considered as a continuous process. Emerging issues in the enterprise should not only be monitored but it should be taken the necessary corrective and / or preventive actions to prevent such problems in the future. To stimulate the process of improving management itself should be involved in the process, to set specific tasks that need to be resolved in the process of improvement, to allocate the necessary resources to achieve these objectives as well as to recognize the improvements.

Thus, the company introduced the HACCP system allows businesses to minimize the risks of hazards, harmonized with the criteria on the basis of food safety requirements entering into force of technical regulations and newly developed technical regulations.

It should be noted that the safety management system of food products aimed primarily at prevention. Critical limits separate safe food from potentially dangerous.

### **REFERENCE LIST**

TR CU 021/2011 Technical Regulations of the Customs Union "On food safety" approved by the decision of the Customs Union on 09.12.2011, the number 880.

Methodological approaches to evaluation of production processes (manufacturing) of food products based on HACCP principles (2014). Guidelines. Federal Service for Supervision of Consumer Rights Protection and Human Welfare

GOST R 51705.1-2001. Quality Systems. Quality management of food based on HACCP principles. General requirements.

Tsareva, G.R (2016), The effectiveness of the quality management system based on HACCP principles at the plant for the production of bakery and confectionery products. Innovations and investments, 6, 68-72

Application of the principles of HACCP in small and medium-sized enterprises-s (2013) Toolkit. Khanty-Mansiysk: Export Assistance Center, 40

Shakirov, IR, Shakirov, GR (2013) Background adoption of technical regulations of the Customs Union TR CU 021/2011 "On food safety". Collection: Regional Aspects of Economics, Management and Law in Modern Society Regional Interuniversity collection of articles. Responsible and Science Editor Arzamastsev, A.D Yoshkar-Ola, 203-210

Solovtsova, O.S, Tsareva, G.R (2014), mission, vision, policies and objectives of the organization in the field of quality. Collection: Product Quality: control, management, improvement, planning collection of scientific papers of the International Youth Scientific and Practical Conference. Editor Pavlov, E.V, 496-499.

Avanesov E.K (2011), HACCP - a synonym for security. Food pro-industry, 10, 13-14