# Quality and safety management at bakeries

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**Abstract.** For bakeries, the main task is to produce bread of the best quality. In order to do this, the company must control the batches of incoming raw materials, semi-finished products and finished products. The quality of bread is a set of characteristics that determine the consumer properties of food products and ensure safety for humans. The use of the HACCP system is currently mandatory and is of great importance in the field of food production. JSC "Saratov bakery named after I.K. Struzhkin" is the main supplier of bakery products in Saratov and the Saratov region. In the work, a survey of all stages of the technological process of the production of bakery products of the therapeutic and preventive direction was carried out, quality management systems were analyzed. Control critical points have been identified, a package of documents and a plan for the implementation of the HACCP system at the Saratov Bakery named after I.K. Struzhkin JSC have been prepared.

## 1 Introduction

Taking into account the development of the food industry and the economic development of the country as a whole, the state has taken steps to create and operate a product quality management system. The most significant for the Russian economy is the creation and development of the Customs Union, which tends to expand [1]. In these conditions, it became necessary to create a unified system of control and quality management of manufactured products, which allows to implement timely measures to prevent, identify and eliminate deficiencies and errors in production, to bring reliable information about the manufactured product to the consumer. To date, the system based on the use of HACCP principles copes with the task best.

## 2 Methods

The purpose of the study is to develop a HACCP plan for an enterprise producing therapeutic and preventive types of bakery products. The object of the study was JSC "Saratov Bakery named after I.K. Struzhkin". Methods of analysis, synthesis and standardized methods for risk analysis: decision tree method, matrix methods [2, 3, 4, 5, 6].

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## 3 Results

JSC "Saratov Bakery named after I.K. Struzhkin" is a large manufacturer of bakery, flour confectionery, cakes and pastries of short-term storage. The design capacity is 50 tons of products per day. Despite the great competition, the bakery continues to hold the main volumes of bakery products sold in the city for different groups of the population and is the main supplier for many commercial enterprises.

Assessing the possibility of implementing the HACCP system for therapeutic and prophylactic products at the bakery, an in-depth analysis of all stages of the bakery production process was carried out in accordance with ISO 2200 "Food Safety Management System" standard and documents were prepared [7,8].

The first stage of the HACCP development process at the enterprise is the issuance of an order on the creation of a working group. The group included a coordinator, a technical secretary, a deputy director for production, a technologist, a chief power engineer, an occupational safety engineer, and a head of a finished product warehouse. The main tasks of the group were the development and implementation of the principles of HACCP, the approval of the HACCP program at JSC "Saratov Bakery named after I.K. Struzhkin".

According to the requirements of the regulatory documentation, a description of therapeutic and preventive products has been prepared. The characteristic of the technology of production of therapeutic and prophylactic bakery products was presented in the form of a block diagram, Figure 1.

Input control of raw materials and materials was carried out for compliance with the indicator provided by the current regulatory and technical documentation, the results of the control are recorded in a journal, the form of which is provided by departmental regulatory and technical documentation.

When developing the HACCP system at JSC "Saratov Bakery named after I.K. Struzhkin", three types of potentially dangerous factors were identified: biological, chemical and physical.

After identifying potentially dangerous factors characteristic of the production of bakery products, the dangerous factors prevailing at each stage of production were indicated, Table 1.

**Table 1.** Hazardous factors of production.

| Stage of the technological process | Hazardous factors |
|---|---|
| Acceptance and storage of raw materials | 1. Birds, rodents, insects and their waste products;<br>2. KMAFAnM;<br>3. BGKP;<br>4. Pathogenic, including Salmonella;<br>5. Pesticides;<br>6. Toxic elements;<br>7. Mycotoxins;<br>8. Infection with the causative agent of the "potato disease" of bread (Bacillus subtilis);<br>9. S. Aureus;<br>10. Mold;<br>11. Contamination and pest infestation of grain stocks (insects, mites);<br>12. Metal mixtures;<br>13. Non-compliance with sanitary and hygienic requirements by personnel;<br>14. Personal belongings. |

| | |
|---|---|
| Preparation and dosing of raw materials | 1. Birds, rodents, insects and their waste products;<br>2. KMAFAnM;<br>3. BGKP;<br>4. Pathogenic, including Salmonella;<br>5. Infection with the causative agent of the "potato disease" of bread;<br>6. Contamination, pest infestation of grain stocks (insects, mites);<br>7. S. Aureus;<br>8. Mold;<br>9. Metal mixtures;<br>10. Non-compliance with sanitary and hygienic requirements by personnel;<br>11. Personal belongings. |
| Kneading the dough | 1. Detergent elements, contaminated containers and equipment;<br>2. KMAFAnM;<br>3. BGKP;<br>4. Pathogenic, including salmonella;<br>5. Non-compliance with sanitary and hygienic requirements by personnel;<br>6 Personal belongings. |
| Fermentation of the dough | 1. Detergent elements, contaminated containers and equipment;<br>2. KMAFAnM;<br>3. BGKP;<br>4. Pathogenic, including salmonella;<br>5. Non-compliance with sanitary and hygienic requirements by personnel;<br>6 Personal belongings. |
| Cutting the dough (dividing into pieces, rounding) | 1. Detergent elements, contaminated containers and equipment;<br>2. KMAFAnM;<br>3. BGKP;<br>4. Pathogenic, including salmonella;<br>5. Non-compliance with sanitary and hygienic requirements by personnel. |
| Proofing of test blanks | 1. Detergent elements, contaminated containers and equipment;<br>2. KMAFAnM;<br>3. BGKP;<br>4. Pathogenic, including salmonella;<br>5. Non-compliance with sanitary and hygienic requirements by personnel;<br>6. Secondary fat oxidation products. |
| Bakery products | 1. Detergent elements, contaminated containers and equipment;<br>2. Non-compliance with sanitary and hygienic requirements by personnel;<br>3. Products of secondary oxidation of fat. |
| Cooling | 1. Birds, rodents, insects and their waste products;<br>2. Detergent elements, contaminated containers and equipment;<br>3. KMAFAnM;<br>4. BGKP;<br>5 Pathogenic, including salmonella;<br>6. Non-compliance with sanitary and hygienic requirements by personnel. |
| Packaging | 1. Birds, rodents, insects and their waste products;<br>2. Non-compliance with sanitary and hygienic requirements by personnel. |
| Stacking | 1. Birds, rodents, insects and their waste products;<br>2. Non-compliance with sanitary and hygienic requirements by personnel. |
| Storage | 1. Birds, rodents, insects and their waste products;<br>2. KMAFAnM;<br>3. BGKP;<br>4. Pathogenic, including salmonella;<br>5. Non-compliance with sanitary and hygienic requirements by personnel;<br>6. Personal belongings. |
| Transportation | 1. Birds, rodents, insects and their waste products;<br>2. Non-compliance with sanitary and hygienic requirements by personnel;<br>3. Personal belongings. |

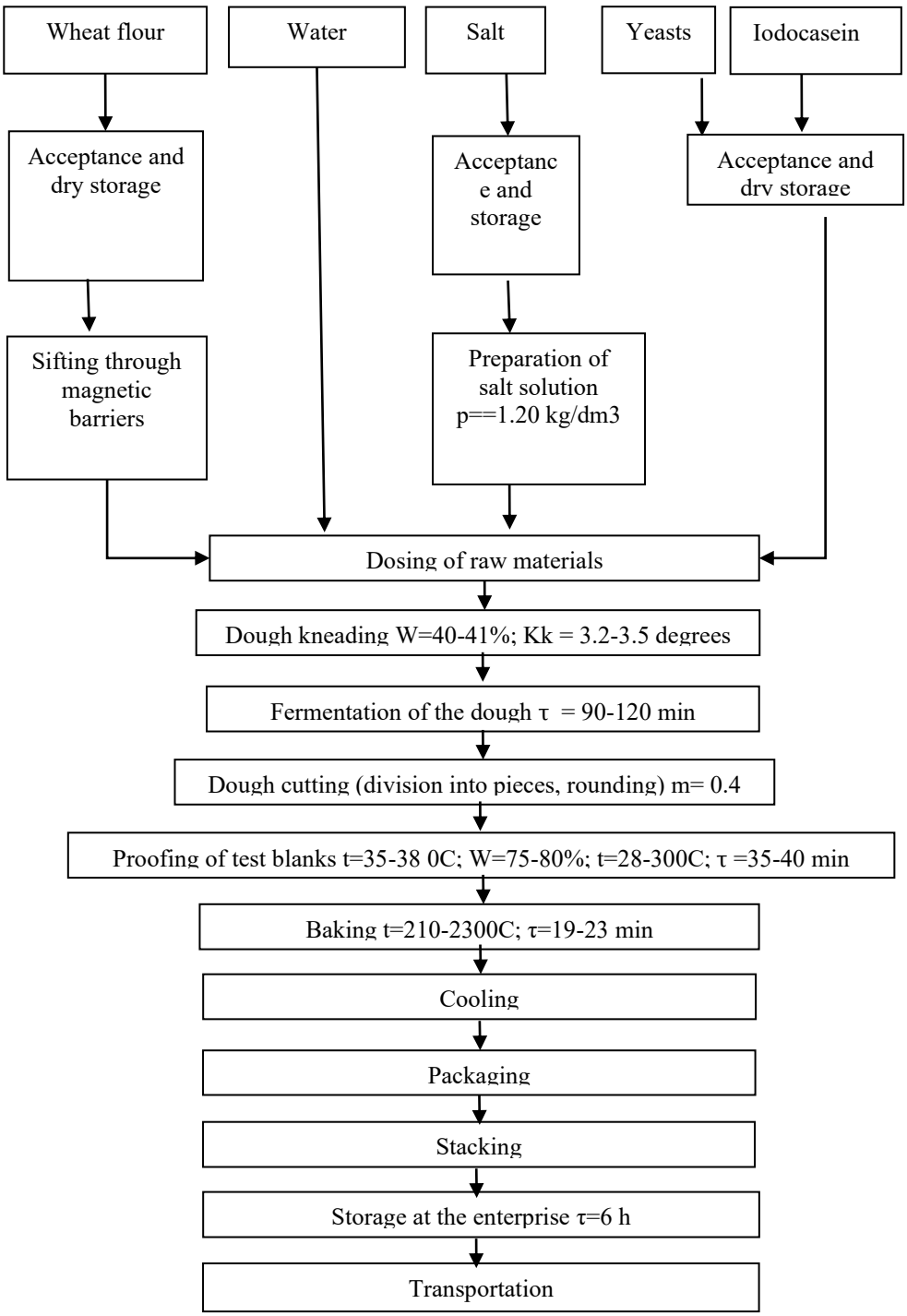


**Fig. 1.** Technological flowchart for the production of a therapeutic and prophylactic product with iodocasein.

Input control of raw materials and materials was carried out for compliance with the indicators provided for by the current regulatory and technical documentation, the results of the control are recorded in a journal, the form of which is provided for by departmental regulatory and technical documentation [9,10].

## 4 Discussion

Based on the results of the analysis from the list of potential factors, a list of factors was compiled for which the risk exceeds the permissible level and actions within the HACCP system are aimed at their transformation (Table 2).

**Table 2.** Considered dangerous factors.

| Name of the hazardous factor | Note |
|---|---|
| KMAFAnM | TR CU 021/2011 |
| BGKP | TR CU 021/2011 |
| Pathogenic including salmonella | SanPiN 2.3.2.1078-01 |
| Pesticides | TR CU 021/2011 |
| Toxic elements | TR CU 021/2011 |
| Infection of b.r. Bacillus subtilis | TR CU 021/2011 |
| Metal mixtures | - |
| Detergent elements, contaminated containers and equipment | - |
| Mould | TR CU 021/2011 |
| S. Aureus | TR CU 021/2011 |

A list of preventive actions for each dangerous factor at all stages of the technological process has been compiled and developed for JSC "Saratov Bakery named after I.K. Struzhkin", Table 3 [11].

**Table 3.** A list of preventive actions at work.

| Name of the operation | Hazardous factors | Preventive actions |
|---|---|---|
| Input control of raw materials | B: KMAFAnM, BGCP, Pathogenic, including salmonella, mold.<br>X: Toxic elements, pesticides, mycotoxins. | Control of the accompanying documentation.<br>Control of the content of the mass fraction of moisture.<br>In case of unsatisfactory results, rejection and return of raw materials to the supplier. |
| Storage | B: Mold | Control of air temperature and humidity. |
| Dosing of raw materials | F: Stones, sand, wood, birds, rodents, insects and their waste products | Technical inspection of equipment, removal of foreign objects, replacement of inoperable sieves. |
| | B: Mold | Control of air temperature and humidity. |
| Kneading the dough | F: Foreign objects | Technical inspection of the equipment. |
| | F: Rodents, insects and their waste products | Disinfection, disinsection. |
| Fermentation of the dough | F: Foreign objects | The presence of covers for the dezh. |
| Cutting the dough | F: Foreign objects | Inspection of equipment every |

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|---|---|---|
| | | shift, hygiene by staff. |
| | F: Rodents, insects and their waste products | Disinfection, disinsection. |
| Packaging, labeling | F: Paper, packaging material | Control of air temperature and humidity. |

According to the data obtained, it was found that each technological operation of the production of bakery products needs strict control, compliance with technological parameters and sanitary and hygienic requirements, Table 4.

**Table 4.** Critical control points for the production of therapeutic and prophylactic products.

| Name of the technological operation | Number of the combined CCT | The number of the original CCT | The considered dangerous factor |
|---|---|---|---|
| 1. Acceptance and storage of raw materials | CCT 1 | CCT 1 | №1 - KMAFAnM |
| | | CCT 2 | №2 - BGKP |
| | | CCT 3 | №3 - Salmonella |
| | | CCT 4 | №4 - Pesticides |
| | | CCT 5 | №5 - Toxic elements |
| | | CCT 6 | №6 - Bacillus subtilis |
| | | CCT 7 | №7 - Metal impurities, impurities |
| | | CCT 8 | №8 - Contaminated containers and equipment. |
| | | CCT 9 | №9 - Mould |
| | | CCT 10 | №10 - S.Aureus |
| 2. Preparation and dosing of raw materials | CCT 2 | CCT 11 | №1 - KMAFAnM |
| | | CCT 12 | №2 – BGKP |
| | | CCT 13 | №3 - Salmonella |
| | | CCT 14 | №6 - Bacillus subtilis |
| | | CCT 15 | №8 - Contaminated containers and equipment. |
| | | CCT 16 | №9 - Mould |
| | | CCT 17 | №10 - S.Aureus |
| 3. Kneading the dough | CCT 3 | CCT 18 | №6 - Bacillus subtilis |
| | | CCT 19 | №8 - Contaminated containers and equipment.. |
| | | CCT 20 | №9 - S.Aureus |
| 4. Fermentation of the dough | CCT 4 | CCT 21 | №6 - Bacillus subtilis |
| | | CCT 22 | №8 - Contaminated containers and equipment. |
| 5. Cutting the dough (dividing into pieces, rounding) | CCT 5 | CCT 23 | №1 - KMAFAnM |
| | | CCT 24 | №2 - BGKP |
| | | CCT 25 | №8 - Contaminated containers and equipment. |
| 6. Proofing of test pieces | CCT 6 | CCT 26 | №8 - Contaminated containers and equipment. |
| 7. Cooling | CCT 7 | CCT 27 | №1 - KMAFAnM |
| | | CCT 28 | №2 - BGKP |
| | | CCT 29 | №3 - Salmonella |
| | | CCT 30 | №8 - Contaminated containers and equipment. |
| 8. Storage | CCT 8 | CCT 31 | №1 - KMAFAnM |
| | | CCT 32 | №2 - BGKP |

| | | | |
|---|---|---|---|
| | | CCT 33 | №3 - Salmonella |
| | | CCT 34 | №6 - Bacillus subtilis |
| | | CCT 35 | №9 - Mould |
| | | CCT 36 | №10 - S.Aureus |

Using the decision tree, 8 critical control points were obtained, according to which monitoring systems and corrective actions were developed, taking into account the nature of the controlled risk, the production process, the capabilities of the enterprise, the qualifications of personnel. The method of monitoring, the frequency of monitoring, the responsibility for monitoring, and the requirements for keeping records during monitoring were determined. The results obtained are presented in Table 5.

**Table 5.** Corrections and corrective actions for CCT.

| CCT No. and the name of the operation | Controlled parameter | Corrective action and correction methods | Responsible | Registration form |
|---|---|---|---|---|
| 1. Acceptance and storage of raw materials | Accompanying documentation; shelf life | Return of raw materials to the supplier, informing management of non-compliance | Storekeeper | Acceptance control log, return certificate, service note |
| 2. Preparation and dosing of raw materials | Foreign objects in raw materials | Technical inspection for foreign objects, repair in case of equipment failure | Plot Master | Journal of technological control, memo |
| 3. Kneading the dough | Foreign objects | Technical inspection for foreign objects, repair in case of equipment failure. Informing the manager. | Plot Master | Journal of technological control, memo |
| 4. Fermentation of the dough | The acidity of the test | Informing the supervisor to make a decision on the further use of the test | Plot Master | Journal of technological control, memo |
| 5. Cutting the dough | Temperature, humidity and acidity | Informing the supervisor to make a decision on the further use of the test | Plot Master | Journal of technological control, journal of temperature control, memo |
| 6. Proofing of test pieces | Temperature and humidity | Temperature and humidity control. Informing the technologist about the violation | Plot Master | Temperature control log, memo |
| 7. Cooling | Temperature | The temperature in the bread storage. Informing the technologist about the violation of the storage duration | Plot Master | Temperature control log, memo |

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| 8. Storage | Temperature | Temperature regulation. Informing the technologist about the violation of the storage duration | Storekeeper | Temperature control log, memo |

As a result of the work done to provide structural units with the necessary and reliable information to perform their functions and measures to ensure safety in the production process, a systematic list of HACCP system documentation was compiled, Table 6.

**Table 6.** List of developed HACCP system documentation.

| **HACCP System Documentation Requirements** | **Content** | **Name of the document** | **Storage location** | **Responsible** |
|---|---|---|---|---|
| 1. The structure of the company | The structure of the enterprise JSC "Saratov bakery named after I.K. Struzhkin" | The organizational structure of the enterprise, the Policy in the field of product safety, the Order on the creation of the HACCP group | Administrative department | Executive Director |
| 2. Documents on supporting actions | Input control of raw materials and materials | The plan of production control of the enterprise | Department of the Chief Technologist | Technologist |
| | The order to work with nonconforming products | Management of nonconforming products | Department of the Chief Technologist | Technologist |
| | Equipment maintenance | Equipment maintenance schedule | Department of the Chief Technologist | Technologist |
| | Cleaning of premises | Cleaning schedule Instructions on the cleaning procedure | Department of the Chief Technologist | Technologist |
| | Cleaning of the territory of the enterprise, garbage collection | Schedule of sanitary cleaning of the territory Garbage collection agreement | Department of the Chief Technologist Department of the Chief Technologist | Head of Production |
| | Мойка инвентаря и дезинфекция технологического оборудования | Schedule of washing and disinfection of inventory and technological equipment Instructions for washing and sanitary-hygienic treatment of inventory and | Department of the Chief Technologist | Head of Production |

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| | | equipment | | |
| | Rodent and insect control | Journal of the sanitary condition of the enterprise<br>Instructions for pest control<br>Contract for the provision of pest control services | Department of the Chief Technologist | Head of Production |
| | Compliance with the rules of personal hygiene | Instructions for personal hygiene<br>Instructional Magazine | Department of the Chief Technologist | Head of Production |
| 3. Product Information | Product safety requirements<br>Names of raw materials and packaging materials, documents confirming safety | List of raw materials and packaging materials used | Department of the Chief Technologist | Technologist |
| 4. Production Information | Description of technological production<br>Location of production sites | Flowchart of the technological process<br>Enterprise plan | Department of the Chief Technologist | Technologist |
| 5. Documents on dangerous factors and risks | Identification of potential hazards, risk identification and selection of considered hazards | List of potentially dangerous factors; Risk analysis and consideration of dangerous factors | Department of the Chief Technologist | Technologist |
| 6. Documents with the definition of CCT | Methods for determining CCT | Results of the analysis using the "Decision Tree" algorithm | Department of the Chief Technologist | Technologist |
| 7. Documents defining critical limits, monitoring systems and corrective actions | Establishment of control objects with indication of technological process operations | HACCP Worksheets | Department of the Chief Technologist | Technologist |
| 8. Accounting documentation | Reflection of the functioning of the HACCP system according to monitoring data, corrective actions, internal audit reports | Control logs; Internal audit checklists | Department of the Chief Technologist | Head of Production |

## 5 Conclusion

Thus, based on the analysis of the production of therapeutic and prophylactic bakery products, the main elements of the quality management system, the HACCP plan have been developed, control critical points have been identified, corrective actions have been established. Documentation and a report system have been created at the bakery enterprise, which can be used to ensure guaranteed production of high-quality and safe products.

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