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# APPLICATION OF HACCP PRINCIPLES TO ENSURE QUALITY AND SAFETY IN THE PRODUCTION OF SPICE AND FLAVOUR COMPOSITIONS BASED ON BIOLOGICALLY ACTIVE SUBSTANCES OF PLANT RAW MATERIALS

**Abstract.** The abstract of the research considers the need to develop effective systems of food quality and safety management in the conditions of rapid development of food industry technologies. Modern consumers strive for products with low calorie content, enriched with useful substances, which requires the creation of new spice and flavour compositions with high biological value.

This study developed a HACCP plan model for a company producing spice and aroma compositions based on sprouted grains for first courses. Three critical control points (CCPs) were identified using a decision tree: the germination stage of the grain, the processing stage during germination and the packaging stage. For each CCP, control measures were identified and a detailed HACCP plan was developed to effectively manage biological, physical and chemical risks, ensuring consistent quality and safety of the final product. Thus, the application of HACCP principles in the production of spice and flavour compositions will significantly improve their safety and competitiveness in the modern market.

**Keywords:** HACCP, quality management system, spice and flavour compositions, critical control points, sprouted cereals.

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**Introduction.** With the rapid development of technology in the food industry, the requirements for the quality and safety of food products, including spice and flavour compositions, are increasing. Modern consumers increasingly choose products with low calorie content, enriched with useful substances and

having functional properties. In this regard, there is a need to develop new types of spice and aroma compositions that not only improve the flavour of food, but also have increased biological value [1,2].

Today, the market offers traditional seasonings of various national cuisines, the quality of which has been shaped over centuries. However, industrial analogues often fail to meet the high expectations of consumers due to simplified compositions and excessive spiciness. To address this problem, innovative approaches are needed that include the use of natural ingredients such as seeds, roots, berries, leaves, fruits and medicinal herbs. The inclusion of such ingredients in seasonings allows the creation of products that not only have unique flavours but also carry health benefits [3]. Increased requirements to the quality and safety of food products necessitate the introduction of effective management systems at enterprises. It is important to take into account both external factors (competition, consumer expectations, quality of raw materials) and internal factors (technological processes, efficiency of quality control system). Special attention is paid to the identification and management of risks at all stages of production [4]. The HACCP (Hazard Analysis and Critical Control Points) system is now a recognised standard for food safety management. Its implementation allows companies to monitor potential risks at every stage of the production chain and react quickly to possible deviations. This system provides a comprehensive approach to quality and safety management, which is especially important in the production of products with high biological activity, such as spice and flavour compositions [5].

Thus, modern seasoning production requires not only innovations in technology, but also careful control at all stages. The application of HACCP principles in the quality management system is relevant. It will significantly improve the safety and competitiveness of products, meeting modern market requirements.

**Materials and methods.** The HACCP model method aims to develop a system that ensures food safety at all stages of production. The HACCP model is based on seven key principles that help to identify and control potential risks.

1. Risk Analysis: The first step is to identify all possible hazards at each stage of production. This is so that the team can assess the risks and develop appropriate measures to eliminate or mitigate them.

2. Identification of Critical Control Points (CCPs): Based on the threat analysis, the KCTs – the stages where controls can be applied to prevent or eliminate threats – are identified. For this purpose, a decision tree is used to help identify such points in a logical manner.

3. Setting Critical Limits: For each KCT, acceptable values (critical limits) are set that must be maintained to prevent risks. In some cases, there may be more than one critical limit.

4. Monitoring system: Monitoring procedures are developed for each KCP to monitor compliance with the critical limits. This is necessary to detect deviations in a timely manner.

5. Corrective actions: If deviations from critical limits are identified, corrective actions are developed. These are aimed at eliminating deviations and restoring control over the KCP.

6. System validation: Regular checks and tests are necessary to validate the effectiveness of the HACCP system. This may include random sampling and analyses to ensure that the system is working correctly.

7. Documentation and record keeping: All steps and activities in the HACCP system should be documented. This is necessary to ensure transparency and efficiency of the system.

These principles help to create a safe food production system, minimising risks to consumers [6-7].

**Research results and discussion.** Critical control points (CCPs) were identified at each production step in the production of spice and flavour compositions based on biologically active substances of plant raw materials using a decision tree. A monitoring system was developed for each CCPs, which allows the control and measurement procedure to be carried out according to a plan and to detect violations of critical limits. A decision tree was proposed to identify the risk factors [8]. The analysis of risk factors within the HACCP system assesses the probability of their occurrence and the potential severity of their impact. At each stage of production, all possible risks are identified and then specific actions and procedures are developed to prevent threats. The HACCP plan includes biological, chemical and physical hazards. For each critical control point (CCPs), the HACCP system provides for the control of all identified hazards using monitoring procedures, corrective actions, and mandatory precautionary actions to ensure that risks are properly managed at each stage of production [9].

Determination of critical control points at the stages of production of spice and aromatic compositions based on biologically active substances of plant raw materials. Hazardous factors are analysed taking into account the probability of their occurrence and potential impact on product safety. All possible hazards are identified at each stage of the production process, after which actions and procedures are developed to prevent them. For example, the greatest danger in the production of spice and flavour compositions based on biologically active substances of plant raw materials, such as sprouted grains, are biological factors. These factors can have serious consequences for human health. Table 1 summarises the results of the analysis, identification of hazardous factors and identification of control measures to manage the production process of spice aroma compositions. Q. 1: Are there controlled preventive measures? Q. 2: Is the stage specifically designed to eliminate or reduce the possibility of threats to an acceptable level? Q. 3: Can the contamination with the found hazards be strongly higher than the permissible level or increase to an acceptable level? Q. 4: Will the next stage eliminate the threats found or reduce the chances and acceptable level of their occurrence?

Table 1

Critical control points and management measures in the production phase of spice and flavour compositions

| No. | Processes | Risk factor | | Control measures (CPP or work instructions) | Q-1 | Q-2 | Q-3 | Q-4 | CCP |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | Reception of raw materials (grains, vegetables and other ingredients) | B | Presence of biological hazards in grain and other raw materials | Microbiological and chemical analysis of raw materials and ingredients. Standard working order for raw materials. Suppliers of materials. | Yes | No | No | – | CCP (MPE) |
| | | Ch | Impurities and residues of heavy metals, chemicals | | | | | | |
| | | Ph | Foreign objects | | | | | | |

*Table 1 (continued)*

| 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 2 | Washing grains (t 18°C) | B | No | Standard working order | Yes | No | – | – | CCP (MPE) |
| | | Ch | Waste of heavy metals, chemicals | | | | | | |
| | | Ph | Foreign objects | | | | | | |
| 3 | Soaking in water (t 18-20°C, 6-8 h.) | B | No | The grain is frozen in water (t 18-20°, 5-6 h.) | Yes | No | – | – | CCP (MPE) |
| | | Ch | No | | | | | | |
| | | Ph | No | | | | | | |
| 4 | Growing grain sprouts (24-72 h., t 21,5°C) | B | No | The soaked grain is sprouted at room temperature for 24-72 hours. Watch with your eyes. Workers ' claims insurance | Yes | No | No | – | CCP (plan HACCP) |
| | | Ch | No | | | | | | |
| | | Ph | Foreign objects | | | | | | |
| 5 | Processing when sprouting grain (every 12 hours) | B | The growth of microorganisms is justified by the expiration date of the disinfectant | When growing sprouts, we process them according to the method, the expiration date of the processing tool is not effective | Yes | Yes | - | - | CCP (plan HACCP) |
| | | Ch | No | | | | | | |
| | | Ph | No | | | | | | |
| 6 | Drying (t 40-45°C,4-5 h. W 14-15%) | B | No | Temperature and humidity are controlled during grain drying (t 40-45°C, 4-5 h. W 14-15%) | Yes | No | – | – | CCP (MPE) |
| | | Ch | No | | | | | | |
| | | Ph | No | | | | | | |
| 7 | Grinding (1-2 mm) | B | No | When grinding, the volume of all ingredients is controlled (sieve No. 1,2, not lower than 80%) | Yes | No | – | – | CCP (MPE) |
| | | Ch | No | | | | | | |
| | | Ph | No | | | | | | |
| 8 | Mixing all ingredients (3-4 min) | B | No | The mixing time of all ingredients is controlled (3-4 min) | Yes | No | – | – | CCP (MPE) |
| 9 | Coating (50 g) | B | Microbial growth due to the release and absorption of moisture from the environment | Humidity control by ensuring room temperature and humidity, testing the package for leakage and humidity. Personnel hygiene routine, requirements for the cleanliness of the packing machine and weighing machine | Yes | Yes | No | – | CCP (plan HACCP) |
| | | Ch | Chemical risk from the material from which the packaging is made | | | | | | |
| | | Ph | Presence of foreign objects during measurement or shaping | | | | | | |
| 10 | Save (12 m, t 18-20ºC, W 75%) | B | No | When storing the finished product, temperature and humidity are monitored | Yes | No | – | – | CCP (MPE) |
| | | Ch | No | | | | | | |
| | | Ph | No | | | | | | |

Hazards in the production process are defined as biological (B), physical (F) or chemical (X) factors that can make a product unsafe for consumption. Table 1 shows the decision matrix diagram analysis for identifying process hazards and critical control points (CCPs). According to the data in the table, there are three CCPs identified in the production process: grain germination stage, germination processing stage and packaging stage.

The grain germination stage has a physical risk due to the possible ingestion of foreign objects. The grain processing stage also has a biological risk - the use of

expired equipment reduces its effectiveness and can lead to product contamination. At the packaging stage, both biological and physical risks have been identified: possible leaks and absorption of moisture from the environment can cause microbial growth, which also poses a threat to product safety. To avoid contamination of foodstuffs, critical limits must be established to define specific quantitative values that can be monitored. The process flow diagram for the production of spice and flavour compositions with the identified risk management measures is shown in Figure 2. Figure 2 shows the process flow diagram for spice and flavour compositions based on sprouted grains. This made the process more open by visually observing the production process. Any potential risks were analysed and risks that could affect food safety and quality were considered, and a definition of KKT was obtained.

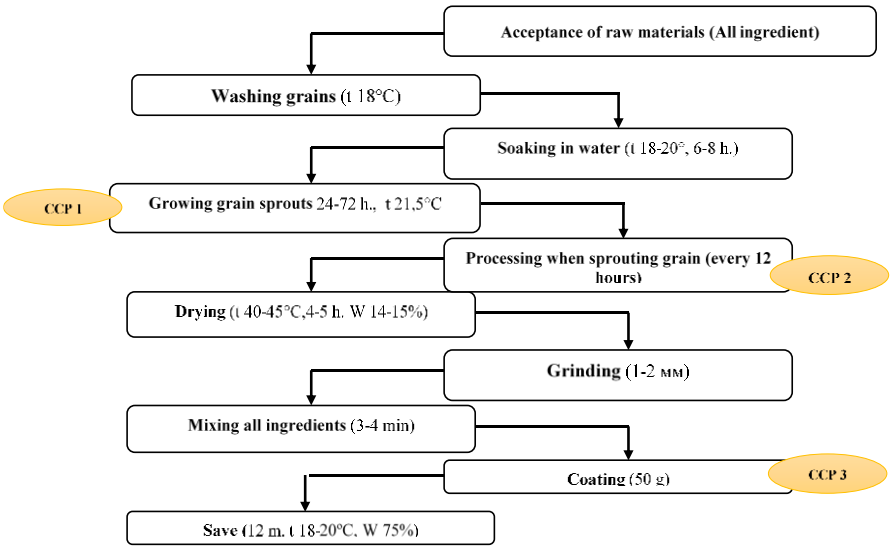


Fig. 2. Process flowchart

HACCP Work Plan.

Once the risk factors have been identified, critical limits must be set and monitoring procedures must be fixed, corrective actions must be taken, i.e., these processes must be applied if the results of monitoring in the TSC show that the process is out of control. A HACCP work plan of critical control points in the production of spice and flavour compositions based on sprouted grains has been developed (Table 2).

Table 2

HACCP work plan

| Process | Growing grain sprouts 24-72 h., W 40-60% | Prepares to process when growing grain sprouts (t 40-45°C, 12 h., W 15-20%) | Coating |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| Danger | Physical danger | Biological and Physical danger | Biological and Physical danger |

*Table 2 (continued)*

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Control measure | Production control | Production control | Control air temperature and humidity. Leak testing |
| Critical threshold | Not allowed | Storage temperature of the preparation (0±5°C) storage period not more than 2 days | There should be no leakage. Control the temperature and humidity of the cladding room (<30°C and <60%) |
| How to | Checking the condition of the warehouse. Control the procedure. Workers ' claims insurance | Temperature time control | Automatic Coating and leakage control in controlled temperature room |
| Who | Production manager | Production manager | Packaging operator and Quality Control Department |
| Frequency | Every day | Every day | Every 30 minutes (checking packages, temperature and humidity) |
| Recording | Control and logging | Control and logging | Leak test report |
| Correctional work | Visual control. Review | Elimination of inappropriate processing drug | Open the finished packaging shell and check the entire batch |
| Solution | The temperature and duration of germination when sprouting grain is fixed | In order to reduce biological risks during the cultivation of grain sprouts, treatment with 3% shakurai aqueous tincture was chosen | Monitoring the temperature and humidity of the packaging room, choosing quality packaging |

Table 2 is the HACCP work plan for spice and flavour compositions based on sprouted grains that potential hazards need to be controlled. This table lists all potential hazards, control point, critical constraints, responsible person, frequency, record, corrective action and verification. Three KCTs were identified: (1) grain germination stage, (2) processing stage during grain germination and (3) packaging stage.

For each control measure, monitoring frequencies and procedures were established to show that the controlled activities are being monitored. These requirements together constitute a monitoring system that provides all planned measurements and observations associated with the threat. Monitoring methods and frequency ensure that exceedances are detected in a timely manner so that product can be isolated prior to use or delivery. Planned adjustments and corrective actions for control points are reflected in the HACCP plan. Therefore, the implementation of the HACCP plan requires the participation of all qualified employees working in production at all stages. In addition, a logical and validated HACCP plan can help food market operators to improve food safety management.

**Conclusion.** In this study, a HACCP plan model was developed for a sprouted grain-based spice and flavour composition manufacturing facility for first

courses to improve product safety and quality. Using a decision tree, three critical control points (CCPs) were identified: (1) the germination stage of the grain, (2) the processing stage during germination, and (3) the packaging stage. Control measures were developed for each CCP and a detailed HACCP plan was developed to effectively manage biological, physical and chemical risks, ensuring consistent quality and safety of the end product.

**References**


1. Analysis of the spice market in Kazakhstan for 2015-2019. "Tebiz Group" [Electronic resource]. Access mode: https://tebiz.ru.10.01.2021. [in Russian].
2. Gavrilova, A. Spetsii i pripravy [Spices and seasonings]. – Moscow: Ripol klassik, 2013. – 128 p. [in Russian].
3. Orynbasarova B.A., Tasybayeva SH.B. Ispol'zovaniye pryano-aromaticheskikh rasteniy Yuzhnogo Kazakhstana v proizvodstve sousov priprav [Use of spicy and aromatic plants of Southern Kazakhstan in the production of sauces and seasonings] //World science. – 2018. – No. 2(30). – P. 72-78. [in Russian].
4. Pozdnyakova N.A. Formirovaniye sistemy kachestva na osnove printsipov KHASSP v ZAO «Glinki» g. Kurgana [Formation of a quality system based on the principles of HACCP in ZAO Glinki, Kurgan] //Bulletin of the South Ural State University. Series: Food and Biotechnology. – 2015. – Vol. 3. – No. 2. – P.72-81. [in Russian].
5. Mardar M., Ustenko I., Macari A, Znachek R. Application of HACCP principles for quality and safety in the development of grain prodacts of weness purpose //Annals. Food Science and Technology. – 2017. – Vol.18. – Issue 2. – P. 144.
6. Mayurnikova L.A., Gubanenko G.A., Koksharov A.A. KHASSP na predpriyatiyakh obshchestvennogo pitaniya [HACCP in catering establishments]: textbook. – Moscow: Lan, 2020. – P. 11-15. [in Russian].
7. Serikbaeva A., Tnymbaeva V., Mardar M., Tkachenko N., Ibraimova S., Uazhanova R. Determining optimal process parameters for sprouting buckwheat as a base for a food seasoning of improved quality //Eastern-European Journal of Enterprise Technologies, – 2021. – No. 4/11 (112). – P. 6-16.
8. Serikbayeva A.N., Tnymbayeva B.T., Ibraimova S.Ye., Dzhumabekova G.SH., Samadun A.I. Razrabotka novogo vida pripravy na osnove prorashchennogo zerna grechikhi sorta «Bogatyr'» [Development of a new type of seasoning based on sprouted buckwheat grain of the "Bogatyr" variety] //The Journal of Almaty Technological University. – 2022. – Vol. 2. – P.73-80. [in Russian].


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## ӨСІМДІК ШИКІЗАТЫНЫҢ БИОЛОГИЯЛЫҚ БЕЛСЕНДІ ЗАТТАРЫНА НЕГІЗДЕЛГЕН АЩЫ-ХОШ ИІСТІ КОМПОЗИЦИЯЛАР ӨНДІРІСІНДЕ САПА МЕН ҚАУІПСІЗДІКТІ ҚАМТАМАСЫЗ ЕТУ ҮШІН НАССР ПРИНЦИПТЕРІН ҚОЛДАНУ

**Аңдатпа.** Зерттеу жұмысында тамақ өнеркәсібі технологияларының қарқынды дамуы жағдайында тамақ өнімдерінің сапасы мен қауіпсіздігін басқарудың тиімді жүйелерін әзірлеу қажеттілігі қарастырылады. Қазіргі тұтынушылар биологиялық құндылығы жоғары жаңа ащы-хош иісті композициялар жасауды қажет ететін пайдалы заттармен байытылған калориясы төмен тағамдарға ұмтылады.

Зерттеу барысында алғашқы тағамдарға арналған өнген дәндерге негізделген ащы-хош иісті композициялар шығаратын кәсіпорын үшін НАССР жоспарының моделі

жасалды. Шешім ағашын пайдалану арқылы үш сыни бақылау нүктесі (СБН) анықталды: дәннің өскінін өсіру кезеңі, өскінін өсіру кезіндегі өңдеу кезеңі және орау кезеңі. Әрбір СБН үшін бақылау шаралары айқындалып, түпкілікті өнімнің тұрақты сапасы мен қауіпсіздігін қамтамасыз ете отырып, биологиялық, физикалық және химиялық тәуекелдерді тиімді басқаруға мүмкіндік беретін НАССР-дің жұмыс жоспары жасалды. Осылайша, НАССР принциптерін ащы-хош иісті композициялар өндірісінде қолдану олардың қауіпсіздігі мен қазіргі нарықтағы бәсекеге қабілеттілігін едәуір арттырады.

**Тірек сөздер:** НАССР, сапаны басқару жүйесі, ащы-хош иісті композициялар, сыни бақылау нүктелері, өнген дәнді дақылдар.

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## ПРИМЕНЕНИЕ ПРИНЦИПОВ НАССР ДЛЯ ОБЕСПЕЧЕНИЯ КАЧЕСТВА И БЕЗОПАСНОСТИ ПРИ ПРОИЗВОДСТВЕ ПРЯНО-АРОМАТИЧЕСКИХ КОМПОЗИЦИЙ НА ОСНОВЕ БИОЛОГИЧЕСКИ АКТИВНЫХ ВЕЩЕСТВ РАСТИТЕЛЬНОГО СЫРЬЯ

**Аннотация.** В аннотации к исследованию рассматривается необходимость разработки эффективных систем управления качеством и безопасностью продуктов питания в условиях стремительного развития технологий пищевой промышленности. Современные потребители стремятся к продуктам с низким содержанием калорий, обогащенными полезными веществами, что требует создания новых пряно-ароматических композиций, обладающих высокой биологической ценностью.

В ходе исследования была разработана модель плана НАССР для предприятия, производящего пряно-ароматические композиции на основе пророщенных зерен, предназначенных для первых блюд. С использованием дерева решений были идентифицированы три критические контрольные точки (ККТ): стадия проращивания зерна, стадия обработки при проращивании и стадия упаковки. Для каждой ККТ определены контрольные меры и составлен подробный план НАССР, что позволит эффективно управлять биологическими, физическими и химическими рисками, обеспечивая стабильное качество и безопасность конечной продукции. Таким образом, применение принципов НАССР в производстве пряно-ароматических композиций значительно повысит их безопасность и конкурентоспособность на современном рынке.

**Ключевые слова:** НАССР, система управления качеством, пряно-ароматические композиции, критические контрольные точки, пророщенные злаки.