Review

HEALTH ASSESSMENT OF INTERNAL HYGIENE CONTROL IN SAUCE PRODUCTION

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Summary

Nowadays, usage of sauces as part of a meal has seen a significant increase. In their diversity as raw materials and technology of production, sauces are a potential source of health problems. During their production, primary and secondary contamination with microorganisms and other physical or chemical contaminants is possible. Ineffective internal control is a prerequisite for the emergence of health problems among consumers. The subject of the study is a sauce manufacturer. An algorithm was designed to perform the audit and for the purposes of the. The prerequisite measures were placed in separate Good Hygiene Practices (GHP) and Good Manufacturing Practices (GMP) programs and in the technological documentation for all the sauces produced, with plans, procedures, orders, instructions, lists, registers and other documents, all closely related to the specifics of production. The technological documentation was found to be in agreement with the Food Safety Management System – the HACCP-plan. The technological documentation, which is part of the prerequisite measures, corresponded to its purpose and, with slight adjustments, is a good basis for the effective functioning of the Food Safety Management System. The conclusions contain specific recommendations for revision of the Internal Control System, including correction of elements of health and hygiene importance.

Keywords: sauces, technological documentation, HACCP-plan, food safety

Introduction

Nowadays, use of sauces as a part of meals has seen a significant increase. The diversity of raw materials and technology of production make sauces a potential source of health problems among consumers. During their production, primary and secondary contamination with microorganisms, as well as with other physical or chemical contaminants is possible. Ineffective internal control is a prerequisite for the emergence of health problems.

The aim of the study was to make a health assessment of the Internal Control System in a plant manufacturing sauces and the HACCP- sauce plan. The team aimed to evaluate the developed and applied good manufacturing and hygiene practices, as well as the developed technological documentation and all

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Received: February 08, 2021
Revision received: February 12, 2021
Accepted: April 22, 2021

records confirming the application of the entire documentation of the food and safety system.

Materials and Methods

The subject of the study is a sauce manufacturer. To achieve the goal of the study, an algorithm was designed. It was based on the methodology of Codex Alimentarius, presented in the document "Food Quality and Safety Systems - A Training Manual on Food Hygiene and the Hazard Analysis and Critical Control Point (HACCP) System. The algorithm included:

- analysis and evaluation of the structure and organization of working process in the enterprise, based on the criteria set out in EU Regulation № 852/2004 [1,2]. The prerequisite conditions and activities, environmental conditions for production and safety of the specific food products were assessed.

- assessment of a potential risk of contamination from the environment with microbial pathogens, chemicals, foreign bodies, agents likely to lead to food spoilage, unacceptable colours and unwanted or pathogenic substances, such as scrapings or decomposing materials" [3,4,5,6,];

- a review of Good Manufacturing Practices (GMP) and Good Hygiene Practices (GHP) available to the business operator - company, industry, and assessment of the possibilities for their application and compliance with the General Principles of Food Hygiene [7,8,9];

- analysis and evaluation of the technological documentation - according to the criteria established in the current national legislation [10];

- analysis and evaluation of the development and functioning of the HACCP system. The analysis performed of the developed and implemented system was in accordance with the Guidelines for the implementation of procedures based on the principles of risk analysis and critical control points in certain areas of the food industry (Brussels, European Commission, Directorate-General for Consumer Health) [11] and covered the following key stages in the development and operation of the HACCP systems:

- aassignment of HACCP tasks by the management of the food company;
- HACCP team assessment;
- assessment of the terms and definitions used in the HACCP documentation and their compliance with the terms and definitions given in the above document;
- evaluation of the product description prepared by the HACCP team, including relevant safety data;
- evaluation of the description of the use of the product - standard, expected, target consumer groups, including vulnerable groups of the population;
- evaluation of the description of the technological process and compilation of a technological diagram with technical data, preparation, processing, packaging, storage, and distribution;
- on-site inspection of the technological diagram;
- assessment of the expected physical, chemical or biological hazards in the individual steps of the technological process and risk analysis of each identified potential hazard on the principle of severity

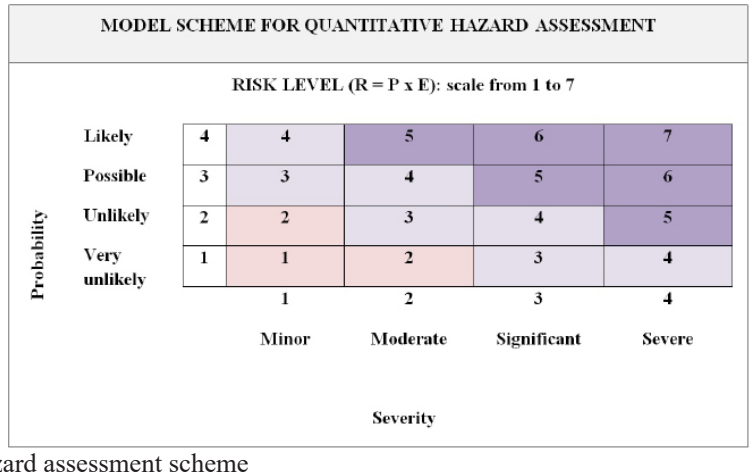

Figure 1. Model hazard assessment scheme

probability - according to the presented model scheme (Figure 1);
- evaluation of the critical control points identified, according to the decision tree algorithm;
- assessment of the parameters of the technological process, which are crucial for elimination or reduction of the level of risk at the critical control points;
- evaluation of the defined critical limits of the parameters for each critical control point;
- evaluation of the system for monitoring the parameters at the critical control points;
- assessment of the proposed corrective actions taken when the monitoring shows that a specific critical control point is out of control;
- evaluation of the established verification procedures, confirming that the HACCP system works effectively;
- evaluation of HACCP documentation - evaluation of the procedures and records suitable for applying the HACCP principles in this particular food production enterprise.

Results and Discussion

The team responsible for quality, safety and the internal control system was well acquainted with modern European legislation in the field of food hygiene [2,11,5,7]. The documentation was developed professionally and methodologically.

Evaluation of good production and hygiene practices

The prerequisite activities were indicated in 10 separate Programs under GHP and GMP in the technological documentation (TD) for all sauces produced, with plans, procedures, orders, instructions, lists, registers and other documents closely related to the specifics of production. Program 1 set out the conditions met by the building stock, infrastructure, premises, their dimensions and the materials from which they are built, the production flows, the sanitary-technical facilities and the production equipment.

Program 2 set out the requirements and conditions under which the incoming control of raw materials, food and packaging materials was performed. The analysis revealed that there were no forms certifying the quality of raw materials that suppliers should provide.

Programs 3, 4, 8 and 10, the requirements were presented for the storage of finished products and raw materials, the hygienic condition of the site, maintenance and methods of disinfection, pest control, control on the drinking water used for production, and transport hygiene. Program 5 set out the requirements and conditions under which the main production operations were carried out, which is closely related to the TD and is the basis for the development of the HACCP system. The main technological processes included high pasteurization, and critical control points had been identified.

Programs 6 and 7 included the requirements for feedback and the procedures to follow when products with quality and safety problems are withdrawn from the market.

With few exceptions, DPHPs are a solid foundation for the HACCP system.

Analysis of the technological documentation

The company produces a wide range of products intended for direct consumption: mustard, and mayonnaise, tomato and culinary sauces. Sauces are essentially emulsion products with high water content and a high amount of technological additives. Six Technological Sets of appropriate documentations had been developed, depending on the differences in the recipes. The main quality, health and hygiene indicators for all the products are presented in Table 1 and Table 2.

The composition of the sauces included a variety of raw materials, including allergens: tomato concentrate, egg powder - yolk, milk powder, vegetable oil, modified starch, dried peppers and chili powder, garlic, parsley and dill, pickles, mustard flour, sugar, and cooking salt. The technological additives used included stabilizers (xanthan gum and guar gum), acetic and citric acids, sucralose, preservatives (potassium sorbate and sodium benzoate), and colorants (beta-carotene and paprika).

The analysis showed that the technology of most sauces did not include heat treatment, which carries the risk of microbial contamination of the finished product with microbes both from raw materials and from secondary contact caused by poor staff and environmental hygiene. Only the composition - low pH, the presence of preservatives and nutrients insufficient for the

Table 1. Health and hygiene and quality indicators for culinary sauces

Type of sauce	Physico-chemical and microbiological indicators and standards							
	Dry matter, %	Salt, %	pH	Fat %	*Salmonella*, в 25 g	Coagulase positive staphylococci, cfu/g	*E.coli*, cfu/g	Mold, Fungi, cfu/g
Mustard	6 - 9	2.5-3.5	3,5-4,5	>5	Absent	< 100	< 10	< 100
Mayonnaise	>7	< 2.5	3,5-4.5	>5	Absent	< 100	< 10	< 100
Sauce "Samurai"	>30	< 2,5	4.0-5.0	>25	Absent	< 100	< 10	< 100
Sauce Garlic and Tartar	>7	< 2.5	3.5-4.6	<12	Absent	< 100	< 10	< 100

Table 2. Health and hygiene and quality indicators for culinary sauces

Type of sauce	Physico-chemical and microbiological indicators and standards						
	Dry matter, %	Salt, %	pH	*Sulfite reducing clostridia, CFU/g*	Mold, CFU/g	*Fungi*, CFU/g	Mesophilic aerobic and facultatively anaerobic microorganisms
Ketchup	> 8	< 2.5	3.5-4.5	< 1	<10	<10	Not allowed
Sauce Chili, Mexican and Barbeque*	>8 >20*	< 2.0	3.5-5.0	< 1	<10	<10	Not allowed

development of bacteria and fungi are limiting factors for the microbial processes. It has been experimentally proven that large doses of viable cells of Salmonella spp. die in mayonnaise products in less than 48 hours, and the microflora does not develop for weeks [12]. In that context, the microbiological criteria for safety and hygiene of the processes were set correctly enough for sauces that are not pasteurized.

The technological processes in producing the different sauces are presented in Figures 2-3.

There is no heat treatment in the production of mustard, Garlic and Tartar sauces and "Samurai" mayonnaise sauce, i.e. there is no microbial decontamination. The composition, high acidity, and preservatives do not provide an environment for microbial processes.

The same refers to the mayonnaise very low fat content sauces, which the company produces. The technology used to produce Chili, Mexican and Barbecue sauces, and ketchup, which are essentially tomato products, includes heat treatment - high single-stage pasteurization (Figure 4).

The differences in composition and processing determine the differences in requirements for microbiological safety criteria, which were compiled similarly to the criteria for production of lyutenitsa and tomato products with preservatives.

Their formulations have to be amended in accordance with the following considerations and suggestions:

- the total number of mesophilic micro-organisms must be no more than 8000 cfu / g;
- the indicator "Enterobacteriaceae" - <10 cfu / g has to be included;
- mold and yeast have to be normalized to <10 cfu / g;
- the criterion "Sulfite-reducing clostridia" has to be replaced with "anaerobic microorganisms are not allowed" according to regulations set in Bulgarian State Standard 6916-87 [13].

In the technological documentation, we identified other discrepancies that could be corrected as follows:

- Depending on the period of development of the TD, it is appropriate to update some of

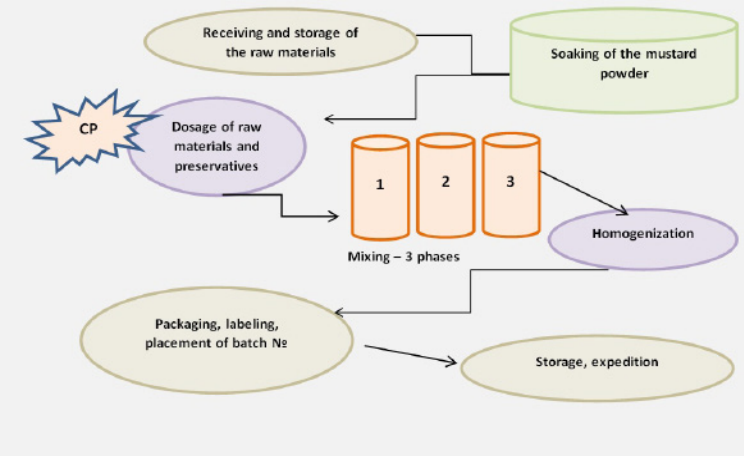

Figure 2. Technological process in the production of mustard

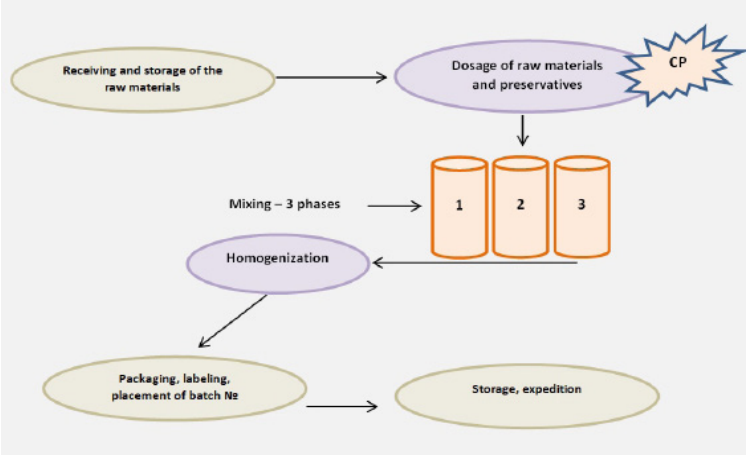

Figure 3. Technological process in the production of mayonnaise, mayonnaise sauce "Samurai", Garlic sauce and sauce Tartar

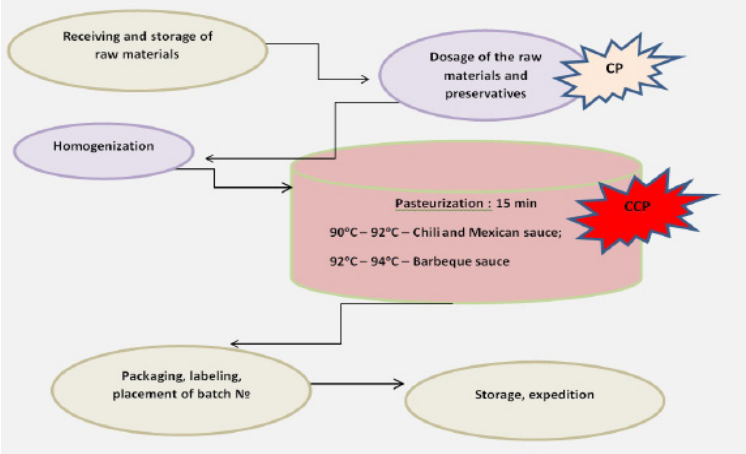

Figure 4. Technological process of the production of Chili sauce, Mexican sauce, Barbeque sauce and Ketchup

their texts in accordance with the changes in the EU Regulations, national by-laws and methodological standards.

- In the nutrition tables it is not necessary to declare the values up to the second decimal place - it is more appropriate to round the numbers.

- It is unwarrantable to entrust the selection of methods for analysis of health and hygiene indicators to accredited laboratories. They must be specified in the text of the TD, as this guarantees the interests of the manufacturer.

Overall, the TD is in line with the HACCP plan. As part of the TD, working cards had been

developed for keeping records of the Control Point (CP) / dosage of preservatives / and Critical Control Point (CCP) / pasteurization /. It was also found that the developed Program for monitoring of the finished products was followed. The TD met their purpose and with the slight adjustments, listed above, the documents are a good basis for the effective functioning of the Food Safety Management System.

Health and hygiene assessment of the HACCP plan

The health and hygiene analysis of the HACCP plan aims to establish the adequacy of the assessment of the health hazards for the consumer, which is crucial for the determination of CP and CCP, for monitoring, corrective actions and verification.

The hazards that come with the raw materials used in the production of sauces and identified by the HACCP team, in addition to the physical, chemical and biological contaminants described above, also include allergens, and most of all mustard powder and egg yolk [14]. Mycotoxins were mentioned vaguely, but without specifying the respective raw materials and eventual measures to prevent them.

Storage has a very limited potential for increased hazards, so heat treatment in some products eliminates microbial contaminants. In sauces produced without heat treatment, the risk of secondary contamination with microorganisms was disregarded by the HACCP team. The risk was not indicated in the relevant work card. However, it was actually control according to the microbiological criteria set out in the TD. The absence of salmonella and staphylococci was normalized only in these products. The limitations imposed by the specific composition of emulsified products on the growth and reproduction of microorganisms justify such an approach.

In sauces not undergoing heat treatment, only critical points (CP) were specified – the dosage of technological additives. The critical limits were set in the recipe. In the pasteurized sauces, the CCP was on the thermal impact - the pasteurization regime, and the critical limits were within the temperatures and exposures already established in the TD. The parameters of the respective monitoring were also given, supplemented by monitoring the water and the working environment.

Verification, in addition to routine inspections, internal and external audits, control of measuring instruments and other mandatory steps, also included observations of finished products, conducted on an annual basis with the mandatory inclusion of the most important safety criteria: the microbiological.

The analysis of the Internal Control System in the production of sauces warrant the following major conclusions:

The various emulsified products, some of which are produced without heat treatment, generally do present health hazards such as for acute foodborne diseases with microbial etiology. Their composition does not allow rapid growth of microorganisms. This also applies to the sauces produced in the plant.

The developed system for internal control and assurance of the quality and safety of the production includes prerequisite Programs for GMP and GHP, Technological documentation for all assortments and a well-built HACCP system, guaranteeing low levels of risk.

The nature of the products, the effective decontamination technologies applied, the systematic maintenance of the hygienic condition of the working environment and the appropriate policy of internal control yield positive results. It is also noteworthy that the composition of the sauces does not allow intensive development of microorganisms.

The HACCP system defines adequate control points (CP) and critical control points (CCP), critical limits and well-documented monitoring of safety factors.

Some elements significant for health and hygiene, in which deficiencies have been identified, could be corrected:

In the Technological documentation, it is necessary to rearrange the microbiological criteria and requirements in accordance by selecting indicators that correspond to the applied technologies and solve the issues of both the biosafety and durability of production [15, 12]:

- the total number of mesophilic micro-organisms has to be no more than 8000 cfu / g;

- to include the indicator "Enterobacteriaceae" - <10 cfu / g;

- mold and yeast have to be normalized to <10 cfu / g;

- to replace the criterion "Sulfite-reducing clostridia" with "elimination of anaerobic microorganisms", since the latter are not allowed" according to regulations set by the Bulgarian State Standard 6916-87 [13].

These criteria should be controlled by verifying the System in accordance with Principle 6.

The technological documentation of most sauces should include the necessity to correct and reduce the salt content, which is above reasonable limits and puts such products in the group of unhealthy foods.

It is necessary to improve the presentation of nutritional information, particularly in regard to allergens, and bring it into full compliance with EU Regulation № 1169/2011 [14].

Conclusion

We believe that the Internal Control System, based on the prerequisite programs, technological documentation and HACCP-plans of the company has been built methodologically correctly and, after minor adjustments, it can be successfully applied. This will provide more reliable conditions for the production of safe and quality products.

The algorithm is based on the methodology of Codex Alimentarius, presented in the document "Food Quality and Safety Systems - A Training Manual on Food Hygiene and the Hazard Analysis and Critical Control Point (HACCP) System. The audit found that the team responsible for quality, safety and the internal control system is well acquainted with modern national and European legislation in the field of food hygiene. The documentation is developed professionally and methodologically and meets the requirements of the regulatory framework.

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