IMPACT OF THE TECHNOLOGICAL PROCESS MANAGEMENT AND CONTROL ON THE ACHIEVEMENT OF SUSTAINABLE QUALITY OF BISCUITS

Marieta Stefanova, Denka Zlateva, Antoaneta Stoyanova

Department of Commodity Science, Faculty of Economics, Varna University of Economics, Bulgaria

Abstract

The quality management and control systems in biscuit production process cover the processes of raw materials supply and their storage under controlled conditions, all the individual steps in the process: preparing and molding the dough, baking, cooling, packaging, as well as shipping and sale of the product on the market. The requirements for achieving continuous, sustainable quality of the biscuit products are met through compliance with regulated activities at each step of the production process.

The aim of this study is to determine the appropriate management and control to be applied at each step of the technological process of producing biscuits, for the purpose of achieving sustainable quality. The study is based on a qualitative approach and constitutes a thorough analysis of the state of quality management in a real situation. The quality of 90 different batches of biscuits produced before, during and after the implementation of a system for monitoring and control of the production processes was examined by sensory parameters. It was found that the sensory parameters of biscuit products manufactured after the implementation of a system for monitoring and control of the technological process had achieved sustainability.

Key words: *food safety, quality management, sensory analysis, biscuit products, sustainable quality*

1. INTRODUCTION

The great popularity of biscuit products worldwide is due to both the wide variety of form and taste and the very long period of minimum durability, compared to most ready-to-eat foods (Manley, 1998). These products are preferred by consumers because of their flavor properties and high nutritional value, determined by the content of sugars and fats (Heiniö, 2006). In recent years the legal requirements regarding the safety of biscuit products have been much more precise and restrictive due to the increasing incidence of product recalls from shops because of incorrect labeling and cross-contamination (Van Hengel, 2007). One such requirement is that each manufacturer has to provide documented evidence that all reasonable precautions have been taken and due diligence has been performed in order to protect consumer health. This in turn necessitates not only taking reasonable precautions (e.g. installing metal detectors and checkweighers), but also establishing rules for monitoring the good operating condition and measurement accuracy of the technical equipment used for monitoring and control (Asselman, 2007), including the records certifying the exercised control (Cauvain, 2008). These and other factors require the introduction of systems for managing the quality and safety of biscuit products, covering the entire production process control activities. The scope of these systems includes measurement and control activities covering the supply of raw materials and their storage in controlled conditions; steps in the technological process, including molding the dough, baking, cooling and shipment and sale of the finished product on the market. The products covered by the system for control and management of the technological processes have very low moisture content and water activity, which guarantees their microbiological safety. For this reason, the confirmation of the adequacy of the applied control requires determination of the changes associated with the sensory properties and Aw.

The aim of this study is to apply the technological process management and control on the achievement of sustainable quality of biscuits, and determine the degree of impact at all steps of the production process to ensure the achievement of sustainable quality.

2. MATERIAL AND METHODS

This study was conducted in two Biscuits factories with a production capacity of approximately 35,000 kg of products per day.

The study covers 6 months (from August 2016 to February 2017) and the researchers have visited the manufacturing sites repeatedly to get acquainted with the ongoing processes and to analyze the ways to achieve sustainable quality of biscuit products.

The study data were collected during the monitoring of the various stages of the steps in the process: preparing and molding the dough, baking, cooling, packaging, as well as shipping and sale of the product on the market. Additional information was obtained from laboratory analyses carried out at the ALIMENTI food safety laboratory and consultation centre for prevention and training, holder of Accreditation Certificate No. A257/14.5.2016.

The test material used consisted of 90 different batches of biscuits produced before, during and after the introduction of the technological process management and control into the manufacturing site (2 months before, 2 months after and 3 months after the introduction of control). The test samples used to determine the sensory parameters are representative of the batch of the particular product. The samples were in the packaging intended for commercial distribution. Immediately before and during the test the samples were exposed to the typical conditions of storage and distribution (light, temperature and variations in relative humidity).

The main methods of analysis of finished products used in the study are:

- Determination of water activity (Aw) according to ISO 21807 "Microbiology of food and animal feeding stuffs. Determination of water activity" (ISO, 2004)
- Sensory analysis was performed by the Descriptive Analysis (Poste, 1991). Describes attribute intensities without assessing liking for them. Relative to standard line scale: much less than standard; just like than standard; much more standard. The panels measure specific sensations, without emotion (no like/dislike), and make them more objective and reproducible. Descriptive Analysis panels typically consist of 9 panelists.

The criteria for assessing the indicators of the test product were complete change of the sensory profile of the product; partial change in the sensory profile of the product (change in one of the indicators); no change in the sensory indicators of the product.

3. RESULTS AND DISCUSSION

The objects of monitoring, measurement and analysis of the technological process management and control were: acceptance criteria for processes; product characteristics; the efficiency of the process. The methods used for quality control and measurement data analysis are consistent with the established goals and policies. The monitoring and measurements are made in accordance with the instructions for the relevant processes and the established working methods. The documented results of the monitoring and measurement activities are analyzed by the company's senior management for the purpose of deciding on the need for change and possibilities for improvement. The records of the results of the monitoring, measurement, analysis and evaluation are kept in accordance with the requirements for storage and management of documented information.

The main objective of technological process management and control is to achieve consumer satisfaction and fulfillment of customer requirements. The level of customer satisfaction is the most important measure of the efficiency of the system and includes: surveys of customer satisfaction, feedback from the customers on the products delivered and services provided, customer surveys, analysis of market share, acclaim, complaints and reports from distributors. Customer service and the key indicators of successful customer satisfaction processes are regularly monitored and reported and reviewed daily. The main trends are analyzed at the monthly management reviews. Customer satisfaction is measured by defining and planning the object of measurement, where and when it will be measured and what methods

will be used. The measurement of achieved goals is carried out by applying the validation and verification processes on the food safety management system and by ensuring that the implemented system has reached the level of control expected of it. Measurements are conducted under controlled conditions, using appropriate calibrated or tested monitoring and measurement instruments.

The company analyzes and evaluates the relevant data and information resulting from the monitoring and measurement, in order to assess the conformity of products and services, the degree of customer satisfaction, in accordance with the diagram presented as Figure 1. Assessing whether the planning has been conducted effectively is part of the activities related to quality management. The food safety team monitors every step of the technological process on the basis of the analysis of hazards. The monitoring activities comprise planned real-time observations or measurements. The data collected from the monitoring allows to assess whether the adopted control measures operate as designed (in the HACCP plan: Critical Control Points and Operational Prerequisite Programs) so as to prevent breach of critical limits.

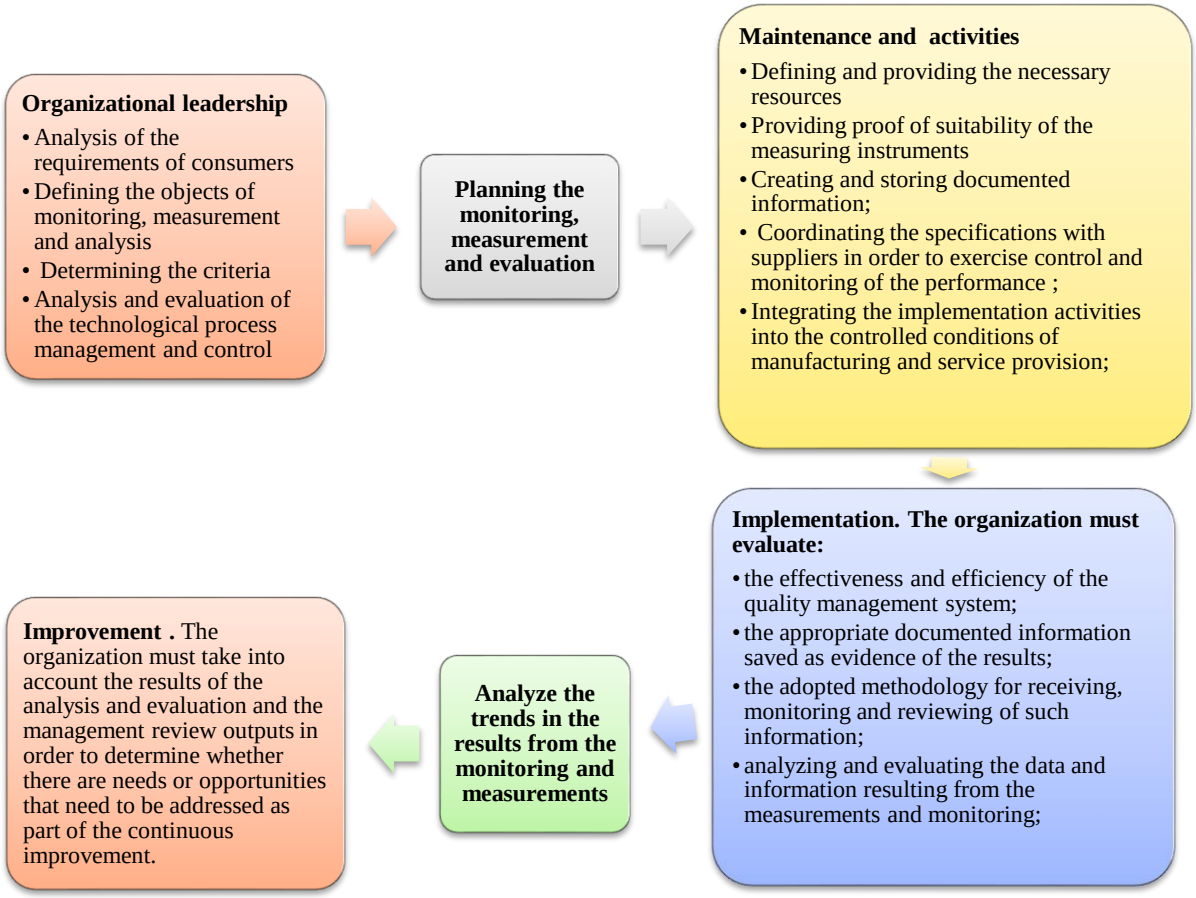


Fig. 1. Model activities of the technological process management and control

The monitoring activities of the technological process management and control (Figure 1) carried out in the organization consist of:

- measurements and observations providing results in a certain timeframe;
- tracking the progress in implementing the biscuit products safety policy, achieving the set goals and their continuous improvement;
- data processing to determine corrective actions where necessary;
- providing data for assessing the efficiency of the system for quality management and food safety.

The planned monitoring is based on the impact of each step in the manufacturing process on the ensuring of sustainable indicators of the quality and safety of finished products. Table 1 shows the different steps of the process of production of biscuit products (column 1), the measurement of various parameters at each step of the process (column 2), aiming to verify whether the technological process management was under control of the manufacturing facility and the results obtained are within the preset limits. The monitoring can be continuous or at regular intervals and the method of monitoring must deliver fast and accurate results on whether the process is under control. The food safety system includes specific corrective actions to be taken when the monitoring shows that there is a tendency for process or particular stage to breach the critical limits or there is lack of compliance with the prerequisite programs. The data from the monitoring of prerequisite programs and critical control points are evaluated and, if necessary, actions are prescribed to ensure:

- identification of the reason for non-compliance;
- return of the controlled parameter within the normal (reference) limits;
- process control in CCP;
- prevention of the recurrence of non-compliance;
- Documentation of the corrective action.

In order to carry out the monitoring it is necessary to define the internal and external limits for control of the target value formed as a result of the influence of the processes laid down in column 2 of Table 1. This is achieved by taking a series of continuous measurements of biscuit products and determining their specification. Since it not always possible to procure and have at disposal for the production raw materials with identical parameters, this requires in practice to make minor changes to the recipe for the dough or to its preparation, in order to ensure the consistent quality of finished products. A necessary condition for the proper functioning of the technological process management and control is to reflect these changes in documented information. The most important measurements in the entire production process are carried out at the exit of the belt furnace on the freshly baked products.

The purpose of the process control introduced is to maintain sustainable production in stable condition while minimizing or increasing the impact of the process at the various technological stages set out in column 2 of Table 1. The purpose of the technological process management and control is to achieve customer satisfaction, which determines the priority of the selected parameters within the scope of monitoring. The exercised control and the settings of the equipment that are introduced with the integrated system at every step of the production process are listed in Column 2 of Table 1.

Table 1. Impact of the technological process management and control on the sustainable quality of biscuits

Stages of production	**Impact of the process on the sustainable quality of the product**
Acceptance of raw materials for contact with foods	The main objective of the process of acceptance of raw materials is to conduct an effective control for compliance with the requirements set out in the specification of the finished product. The acceptance of raw materials with degraded organoleptic and physicochemical properties can deteriorate the quality characteristics of the product. The incoming raw materials must comply with the coordinated specifications. Due to the critical importance of this process to the quality of the products, a procedure has been developed involving all requirements to the acceptance of raw materials. The procedure focuses on the rules for disposing of non-specification raw materials and the methods of analysis used, so as to prevent acceptance of any intentionally or unintentionally altered materials. All of the accepted raw materials must meet the acceptance criteria defined in the classification for incoming inspection

	and the specifications. If there is a deviation from the planned and approved specifications and parameters, such raw materials should be treated as non-compliant products.
Storage of raw materials	The reason for deterioration of the quality of biscuits resulting from the storage of raw materials may be found in the possibilities for cross-contamination. Storage of basic raw materials in silos contributes significantly to improving the efficiency and helps to minimize the risk of microbial and cross contamination of raw materials (Manley, 1998). Most bulk raw materials for production of biscuits absorb moisture. The moistening of raw material during storage may result in degradation of sensory characteristics of the products. Sugar particle size is of great importance for the compliance with the specification of most biscuits.
Transportation to processing sites	During transportation the raw materials can significantly deteriorate their quality, and there is a risk of rupture of transportation package. Cross-contamination may occur if the hygiene standards for the places where the raw materials would be transported are neglected.
Dosing of raw materials	This process requires the dosing of raw materials to be executed with adequate precision, so that the biscuits meet the specification. Incorrect dosing of raw materials cannot be remedied by subsequent production processes. In case of deviation from the approved specifications for quantities and input sequence of the raw materials, it is necessary to treat the end products as non-compliant products, and scrap and destroy them. The excess or shortage of raw materials affects the quality of the product, which is why such product is defined as non-compliant. The adequate accuracy of measurement of the ingredients is a basic requirement for obtaining sustainable quality (Baixauli, et al., 2007). The correct measurement of the quantity of ingredients added in the dough is a critical moment in the management of the process (Almond, 1989). Errors in measured quantity, especially of raw materials constituting less than 5% of the product per recipe affect not only the quality of biscuit products, but also the entire production process. All the raw materials used as ingredients may have more than one function in the formation of the sensory characteristics of the product.
Whipping and/or kneading	Four main processes during whipping and kneading affect the sensory properties of biscuits: − achieving good mixing of all ingredients until homogeneous dough is obtained; − hydration of the flour; − emulsification of water with fat and other ingredients; − activation of the leavening agents in the mixture. The main objective of this process is to achieve the desired extensibility of the dough and make it suitable for forming sheets and cutting. There are various types of mixers, various applications according to the type of the resultant dough. The rotation speeds at which the equipment is set affect and are critical to the quality and homogenization of the dough (Contamine, et al., 1995). The duration of the mixing process affects the rheological properties by increasing the conformity, and the viscosity of the dough can be used as an indicator of the quality of the end product (Manohar & Rao, 1997). A study conducted in 2007 demonstrated a clear correlation between the properties of the dough, the texture of the biscuits and the sensory properties of the end

	product (Edoura, et al., 2007). The quality of the dough is determined by the recipe, the nature of the raw materials used and the manner in which they are homogenized during mixing. Changes in the quantity of ingredients lead to changes in the structure of products (Zoulias, et al., 2002). The structure of the biscuits is determined by their physical properties. It has been established that the texture is a critical sensory indicator for the consumption of biscuits and determines their quality (Gaines, et al., 1992);
Molding	The molding process determines the appearance of the biscuits. The efficiency of this process and its impact on the quality depend on the width of the belt furnace and the distance between the biscuits, which must provide for the products' volume increase during baking. The start of the process before the beginning of the fermentation process, the development of gluten and the constant temperature of the dough are critical for controlling the quality of the end product. (Rao & Manohar, 2002).
Glazing	Biscuits are highly hygroscopic and absorb moisture from the environment which may degrade the flavor properties and may cause softening of the otherwise crisp product. The risk of moisture uptake can be minimized through the process of glazing. The viscosity of the glazing agent should be appropriate for its easy application and such that can withstand high baking temperatures without deteriorating the sensory properties of the product. Critical to the process are the thickness and uniformity of the glazed layer. The glazed layer should not separate partially or entirely from the baked products. The positive impact of the Maillard reaction may be used, by coating the products with milk. Due to the high content of protein and amino acids the glazed layer will contribute to the formation of a darker brown colour of the end products.
Sprinkling after molding	Sprinkling of biscuit products is used to give the product an attractive appearance and improve its taste properties. In this process the risks of quality deterioration have to do with: − Using unsuitable type of biscuits to be sprinkled (curved and with domed tops). Very fragile biscuits may not withstand the weight of the materials used for sprinkling. − the sprinkle layer may not adhere well to the biscuit itself;
Baking in conveyor belt / rotary furnaces	The baking process is critical for the quality of the end products due to the significant changes that occur from the dough piece to the baked product. The more important of these are: − development of the texture and consistence; − reducing the moisture content; − Formation of the colour of the biscuit. Some biscuits should have light colour (e.g. shortbread) while others should have a dark uniform colour without burns along the edges. This specificity of colour requires different baking arrangements. The appearance of the product can be improved through the control of three reactions during baking: − caramelization, resulting from the destruction of the structure of the sugar under high temperatures;

	− browning, resulting from the destruction of the structure of starch by heating, which determines the colour and taste of the end product; − non-enzymatic browning reaction (Maillard reaction), which occurs in the final stage of baking between amino compounds and sugars at high temperatures. These three reactions are critical for determining the consistence, texture, density, taste and colour of the biscuits. For this reason the temperature of the biscuit product after exiting the tunnel furnace is recorded as critical control point.
Cooling after baking	The temperature of the biscuits upon exiting the belt furnace is about 100˚C. This means that the products should be cooled to prevent condensation inside the packaging. The rate and duration of the process depend on the thickness and shape of the product. The cooled products should have a temperature of 40°C, and those which will be sandwiched with cream or glazed must cool down to a temperature that is lower than that of the cream or glaze. An important requirement for the proper development of the process is not to cool too quickly the surface of the baked product. This will prevent the condensation of the moisture. If possible, the cooling must take place slowly and at room temperature.
Cream laying	Biscuit fillings consist mostly of sugar and fat. In most recipes the cream in biscuits constitutes about 30% of the weight of the finished product. The cream has to be homogenized well and with suitable consistence, allowing it's laying. The water activity values for the biscuit and the cream should not differ much in order to prevent migration of moisture between the layers. Biscuit fillings are varied in flavor, colour and taste properties. The cream should not spread beyond the outline of the shape of the biscuit.
Sprinkling after laying the cream	The risks of deterioration in this process are related to: - Use of insufficiently cooled biscuits; - Lack of good adherence between the sprinkles layer and the biscuit itself;
Cooling after laying the cream	After laying the cream the biscuit products must undergo a process of cooling to solidify the cream. Cooling should continue until the desired hardness is achieved. The temperature of the cooling air must be regulated so as not to reach the dew point and avoid condensation. This would affect the microbiological safety of the finished products. For this reason a monitoring of the temperature of the biscuit product is performed after its leaving the cooling tunnel as a critical control point.
Coating	The sensory characteristics of the coating are crucial to avoid cracking and deformation. The coating mixture must be adequately tempered beforehand and with proper consistence. In its essence the layering of the coating is a mechanical process and depends on the appropriate temperature of the blowing module. The temperature of the coating module must be equal to the temperature of the coating mixture. The too strong or too weak blowing has a negative impact on the weight of the end product. A confirmation of the correct process of coating is the resultant gloss of the end product.
Cooling of the end product	It is necessary to cool down the products after their exit from the coating module for the purpose of hardening of the coating and to avoid condensation inside the packaging. The rate and duration of the process depend on the

	thickness and shape of the product. The cooled products must reach a temperature lower than the ambient temperature, the cream or the glaze.
Arrangement and weight control	The control of the weight of the biscuit products is critical for fulfilling the legislative compliance requirements. The offering of products with weight lower than the one indicated on the packaging is treated as misleading of the consumer and is punishable by fines under the Consumer Protection Act. The legislation requires the implementation of a procedure to manage the process, whose purpose is to determine the methodology and define the methods and frequency of the checks of the net quantities of prepackaged products intended for sale "by weight", which quantities are pre-selected and marked on the packaging by the manufacturer. To minimize the risk of delivery of products not meeting the specification weight, a check is performed of the weight of every 10th package of biscuits every hour. On the conveyor belt an operator measures the quantity of the biscuits arranged on a pad before their foiling.
Check the end product with metal detector of	The processing of food is always associated with a risk of cross contamination with foreign objects. Sources of physical contaminants can be: raw materials, packaging materials, process equipment, lighting fixtures, glass, staff and others. All reasonable steps should be taken to ensure that contamination with foreign objects is prevented. Foreign objects have different density from that of the biscuit, and this can be used for their detection through X-ray radiation.
Packaging	The main function of packaging is to protect the biscuit products from mechanical damage and contamination and to prevent the moisturizing of the product. Commercially available products must be in suitably sized packages, which should protect the product from deterioration of the sensory characteristics. Some of the legislative requirements relating to labeling are: providing information on the package about manufacturer or the merchant, net weight, energy value and ingredients. Some biscuits have edges or embossed surface, so it is necessary to use appropriate packaging materials to prevent rupture of the package. The oxidation of fat leads to rancidity and this may be triggered by exposure to light. Biscuits absorb easily extraneous odours, which may degrade their taste and aroma properties. Paper packages are not a good barrier against the absorption of extraneous odours, so the biscuits should not be stored near detergents or other odorous products. The sale of biscuit products is influenced by the appearance of the package, which is why errors in the printing of information must be removed before the product reaches the market.
Final inspection of the finished product	The scope of the control is determined depending on the importance of an operation for the quality of the product, as well as on the complexity of the control itself, and is prescribed in the technological documentation, which specifically defines the parameters to be measured, and the means to be used for this purpose. To minimize the risk of offering for sale biscuits that do not meet the specification, the prescribed and performed control should be: - mandatory for all products;

	- regulated (sequence and scope) and performed in accordance with specific technological documentation made available to all participants in the process; - performed by qualified and specially authorized personnel using the available resources to monitor and measure; - should include internal and external analyses covering raw materials, semi-finished and finished products, as well as technological equipment and materials for packaging. Test results should be documented in the Register of microbial samples; - should include microbiological, physical and chemical analyses demonstrating that the requirements to the product are met, as prescribed by the technological documentation and the applicable legislation. The analyses required for this purpose should be carried out internally in the company and/or by an external contractor; Internal organoleptic tests are conducted in accordance with the specifications, in order to validate the quality and safety of the finished products, and these are regularly documented in the laboratory journal; The final control comprises the following actions: – In case of non-compliance the batch is scrapped and/or destroyed; – If the products comply with the quality requirements, the batch is accepted.
Storage	Storage takes place in a separate storage room designated as "Finished goods" where the products are stored separated by type. The storage of finished products is organized so as to provide protection from contamination and damage. The arrangement of the finished products is made so as to avoid harmful interaction between the products, at a distance from the walls, ceiling and floor, and allowing access to conduct handling and control activities. Regular checks of the temperature of the storage room are made and the results recorded as documented information. All storage rooms for finished products are labeled and ensure the preservation of the quality and safety of the products and prevent deterioration of their characteristics.
Shipping	The arrangement of the finished products is made so as to prevent harmful effects, aiming to avoid deterioration of the characteristics of the products. The organization of the storage facilities involves observance of the rules preventing the perishing of products such as: FE-FO („first expired - first out"), i.e. handling the batch with the smallest remaining shelf life; FI-FO ("first in - first out").
Transportation	The mode of transport and the customer requirements related to shipping and delivery are determined at the time of acceptance of the order or entry into the contract. In all cases the requirements to the hygiene in the vehicles are fulfilled. The documents required under contractual arrangements and legislation accompany the product and are available at the time of delivery, as well as protected against loss and damage.

The requirements for achieving continuous and sustainable quality and safety of the biscuit products are met through compliance with the prescribed activities in each step of the production process. The frequency and scope of the control depend on the impact of the particular technological stage on the quality of the finished products. The forms of control in every step of the production process have been assessed and serve as basis for the formulation of the management rules incorporated. The maintenance and continuous improvement by controlling the steps of the production process is a necessary and sufficient condition for achieving sustainable results from the conducted studies on sensory and microbiological parameters of the products. A basic requirement to all processes studied is the need for an adequate and regular assessment of compliance to the baseline level. The exercised control as part of the technological process management through an integrated approach could not only protect the interests of consumers by ensuring product quality, but also develop a comprehensive quality management system for the organization.

The process of validation (confirmation) creates assurance that the combination of control measures applied in the production of biscuits allows achieving the expected results. Before the introduction of the control measures presented in Table 1, verification should be carried out that:

- the selected control measures are able to achieve the expected control on those risks, for which they were introduced;
- the control measures are efficient and can create conditions for achieving sustainable quality of the production.

The activities carried out to verify the adequacy of the exercised control showed that the system operates as designed, based on tests carried out. Verification (check) is defined as the application of methods, procedures, tests and evaluations, in addition to process monitoring, to determine whether a control measure is functioning as intended.

The analyses performed at the accredited laboratory Alimenti confirmed that biscuits produced in different periods of time have permanent and unchanging quality after the introduction of the control system.

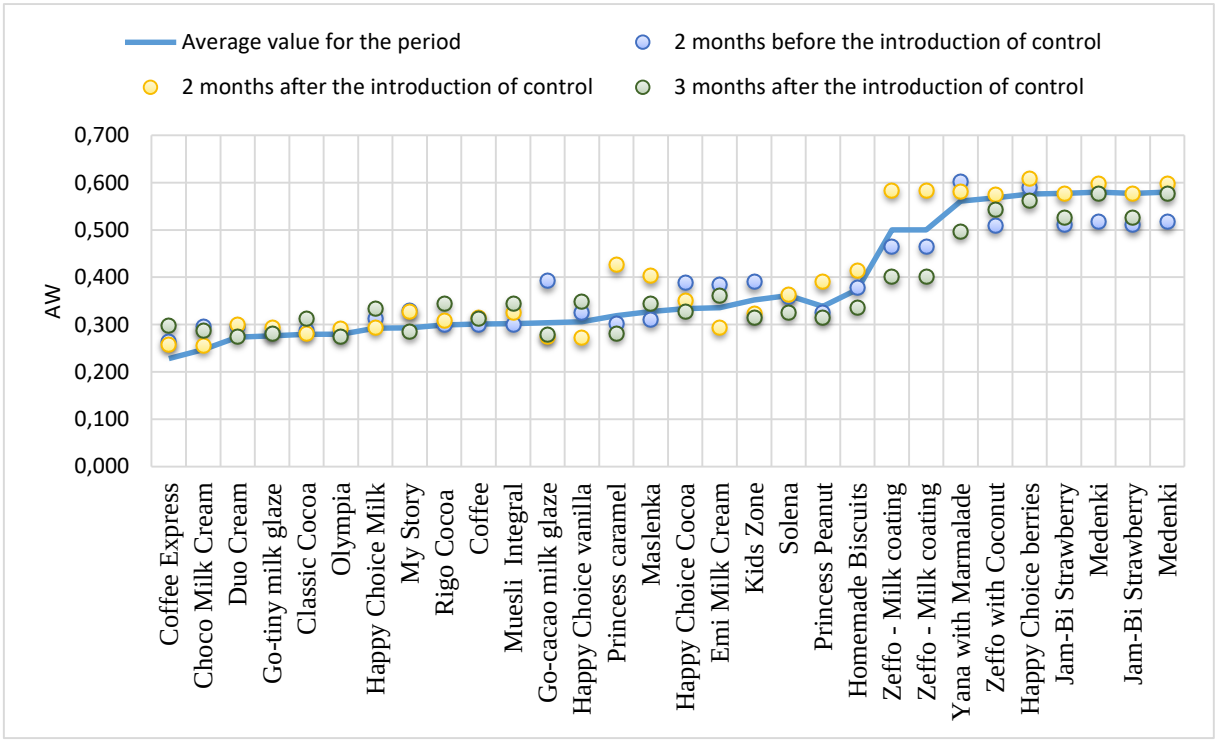


Figure 2. Results from the water activity analysis performed

The analyses performed in an accredited laboratory confirm that the biscuit products have no increase in the values of the indicator water activity. Higher values of water activity are observed in the products Zeffo - Milk coating; Jam-Bi Strawberry; Yana with Marmalade; Medenki; Zeffo with Coconut, Happy Choice berries, for which there are measured values between 0,466 and 0,608. All measured values of the indicator water activity of the studied 90 products are Aw<0,61. This guarantees that their safety has been confirmed.

Table 2. Results from the sensory analysis

№	Trade name of the biscuits	E 1	E 2	E 3	E 4	E 5	E 6	E 7	E 8	E 9
1.	Coffee Express	+	+	+	+	+	+	+	+	+
2.	Choco Milk Cream	+	+	+	+	+	+	+	+	+
3.	Duo Cream	+	+	+	+	+	+	+	+	+
4.	Go-tiny milk glaze	+	+	+	+	+	+	+	+	+
5.	Classic Cocoa	+	+	+	+	+	+	+	+	+
6.	Olympia"	+	+	+	+	+	+	+	+	+
7.	Latino Cocoa	+	+	+	0	+	+	+	+	+
8.	Grissini	+	+	+	+	+	+	+	+	+
9.	Happy Choice Milk	+	+	+	+	+	+	+	+	+
10.	My Story	+	0	+	+	+	+	+	+	+
11.	Rigo Cocoa	+	+	+	+	+	+	+	+	+
12.	Coffee	+	+	+	+	+	+	0	+	+
13.	Muesli Integral	+	+	+	+	+	+	+	+	+
14.	Go-cacao milk glaze	+	+	0	+	+	+	+	+	+
15.	Happy Choice vanilla	+	+	+	+	+	+	+	+	+
16.	Cocoa and Milk	+	+	+	0	+	+	+	+	+
17.	Princess caramel	+	+	+	+	+	+	+	+	+
18.	Maslenka	+	+	+	+	+	+	+	+	+
19.	Happy Choice Cocoa	+	+	+	+	+	+	+	+	+
20.	Emi Milk Cream	+	+	+	+	+	+	+	+	+
21.	Princess Peanut	+	+	+	+	+	+	0	+	+
22.	Kids Zone	+	+	+	+	+	+	+	+	+
23.	Solena	+	+	0	0	+	+	+	+	+
24.	Homemade Biscuits	+	+	+	+	+	+	+	+	+
25.	Zeffo - Milk coating	+	+	+	+	+	+	+	+	+
26.	Jam-Bi Strawberry	+	+	+	+	+	+	+	+	+
27.	Yana with Marmalade	+	0	+	+	+	+	+	+	+
28.	Medenki	+	+	+	+	+	+	+	+	+
29.	Zeffo with Coconut	+	+	+	+	+	+	+	+	+
30.	Happy Choice berries	+	+	+	+	+	+	+	+	+

Relative to standard line scale:
(-) - much less than standard between test samples
(0) - minor differences with the standard between test samples
(+) - just like than Standard between test samples

The verification of the adequacy of the control proved that the system operates as designed according to the performed tests. The verification (check) is defined as the application of methods, procedures, tests and assessments in addition to the monitoring of the processes in order to determine whether a control measure is functioning as intended.

The analyses made at an accredited laboratory confirm that the biscuits produced during different periods of time have a permanent and unchanging quality after the introduction of the control system of the technological process management and control as model in accordance with the diagram presented as Figure 1.

Table 2 shows the results of the sensory analysis performed by the method of descriptive analysis of biscuit products. Deviations from the specified parameters were registered in 8 of the 90 different products examined: four of the ten biscuits were structurally damaged; three of the ten biscuits in the package had small minor damage to the upper surface; one of the biscuits in the package were broken and crushed.

The performed sensory analyses of 90 different batches of biscuits confirm that, with small deviations before the introduction of the control system, the products have stable sensory properties.

The control exercised as part of the quality and product safety management system through an integrated approach could not only protect the interests of consumers by ensuring the quality of the product but could also develop a comprehensive quality management system of the organization's activities.

4. CONCLUSIONS

The implementation of technological process management and control can provide all the necessary and sufficient conditions to meet the compliance requirements. The exercise of adequate control with appropriate periodicity is an important condition to ensure minimizing the risk of having products which do not comply with the regulatory requirements and the specifications. Sustainability of sensory parameters was registered in 90 different batches of biscuits produced before, during and after the introduction of technological process management and control.

The water activity and sensory analyses performed confirmed that despite of the numerous risks technological process management and control is able to affect the quality of the products and the sustainability of parameters. The technological process management and control allows maintaining sustainable quality of biscuit products.

REFERENCES

Almond, N., 1989. Biscuits, Cookies And Crackers, Band 2, The Biscuit Making Procees.. 2 ed. London and New York: Elsevier Applied Science.

Asselman, A. v. S. G. B. R. M. E. D. C. &. v. B. A. J., 2007. Quality prediction of bakery products in the initial phase of process design. Innovative Food Science & Emerging Technologies, 8(2), pp. 285-298.

Baixauli, R., Sanz, T., Salvador, A. & Fiszman, M., 2007. Influence of the dosing process on the rheological and microstructural properties of a bakery product. Food Hydrocolloids, 21(2), pp. 230-236.

Cauvain, S. P. L. S. Y., 2008. Baked products: Science, technology and practice.. 2nd ed. s.l.:John Wiley & Sons.

Contamine, A., Abecassis , J., Morel, H. & Vergnes , B., 1995. Effect of mixing conditions on the quality of dough and biscuits. Cereal chemistry, 72(6), pp. 516-522.

Edoura, G., Allais, R., Trystram, G. & Gros , J., 2007. Influence of aeration conditions on physical and sensory properties of aerated cake batter and biscuits. Journal of food engineering, 79(3), pp. 1020-1032.

Gaines, C., Kassuba, A. & Finney, P., 1992. Instrumental measurement of cookie hardness. Cereal Chemistry, 69(1), pp. 115-119.

Heiniö, R. L., 2006. Sensory attributes of bakery products. Bakery products: science and technology. 2nd ed. Chicago: John Wiley & Sons, Inc. .

ISO, 2004. ISO 21807 „Microbiology of food and animal feeding stuffs — Determination of water activity“. First edition ed. Geneva: International Organization for Standardization.

Manley, D., 1998. Biscuit, Cookie, and Cracker Manufacturing, Manual 1: Ingredients.. Vol. 1 ed. London: Woodhead Publishing.

Manohar, S. & Rao, P., 1997. Effect of sugars on the rheological characteristics of biscuit dough and quality of biscuits. Journal of the Science of Food and Agriculture, 75(3), pp. 383-390.

Poste, L. M. M. D. A. B. G. &. L. E., 1991. Laboratory methods for sensory analysis of food. 2nd ed. Ottawa: Canada Communication Group.

Rao, P. H. & Manohar, S. R., 2002. "Interrelationship between rheological characteristics of dough and quality of biscuits; use of elastic recovery of dough to predict biscuit quality.". Food Research International, 35(9), pp. 807-813.

Van Hengel, A. J., 2007. Declaration of allergens on the label of food products purchased on the European market. Trends in food science & technology, 18(2), pp. 96-100.

Zoulias, E., Oreopoulou, V. & Tzia, C., 2002. Textural properties of low-fat cookies containing carbohydrate-or protein-based fat replacers. Journal of Food Engineering, 55(4), pp. 337-342.