MICROBIOLOGICAL RISK ASSESSMENT AND PREVENTIVE ACTIONS IN BAKERY AND BEVERAGE INDUSTRIES IN ESTONIA, SLOVENIA AND TURKEY

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INTRODUCTION

Risks from microbiological hazards are of immediate and serious concern to human health. Microbiological Risk Analysis (MRA) is a process consisting of three components: risk assessment (RA), risk management (RM), and risk communication (RC), which have the overall objective to ensure public health protection. The MRA process should include quantitative information to the greatest extent possible in the estimation of risk. A MRA should be conducted using a structured approach. Since MRA is a developing science, implementation of the guidelines may require a period of time and may also require specialized training in the countries that consider it necessary. This may be particularly the case for developing countries. This document deals with risk assessment, which is a key element in assuring that sound science is used to establish standards, guidelines and other recommendations for bakery and beverage safety to enhance consumer protection and facilitate international trade. This document will be of primary interest to governmental and research

organizations, companies, and other interested parties who need to prepare a MRA will find it valuable.

MICROBIAL RISK ASSESSMENT AND PREVENTIVE ACTIONS

Risk analysis in the field of food safety is a rapidly developing series of activities and during the recent years several symposiums have been addressed to the principles of the risk analysis framework (Anon., 1997b). RA is the scientific evaluation of the probability of occurrence of known or potential adverse health effects resulting from exposure to biological, chemical or physical factors in the food. There are several opened questions around the terminology and methods associated with RA and hazard analyses. The common and most important objective of the activities is to provide scientific and experimental based risk estimates in order to manage food safety (Syposs *et al*., 2005). The overall objective of RA is to provide estimates on the probability of disease occurrence using a well-structured approach according to the four steps suggested by the Codex Alimentarius Commission: hazard identification, hazard characterization (dose-response), exposure assessment and risk characterization (Anon., 1997b). The integration of quantitative risk assessment (QRA) models with the related food safety issues at international/national level, might be the driving force to improve and adopt these models by addressing purely business risk in cases where the food safety parameters are not, or likely not to deteriorate, however the level of risk to the business is still high. Based on the scope of the assessment, QRA was used as a process by which the results of the hazard analyses were used to make business decisions, which might not necessarily impact the food safety parameters of bakery and beverage products.

Effective management of microbiological hazards is enhanced through the use of tools e.g. MRA and Hazard Analysis and Critical Control Point (HACCP) systems. Sound MRA provides an understanding of the nature of the hazard, and is a tool to set priorities for interventions. HACCP is a tool for process control through the identification of critical control points. The ultimate goal is improvement of public health, and both MRA and HACCP are means to that end. In the 30 years since its conception, the HACCP system has grown to become the universally recognized and accepted method for food safety assurance. The recent and growing concern about food safety from public health authorities, food industry and consumers worldwide has been the major impetus

in the application of the HACCP system. The Codex Code on General Principles of Food Hygiene has also been revised to include recommendations for the application of the Codex HACCP Guidelines. In turn, all relevant Codes of Hygienic Practice are being revised to include HACCP Principles. The Codes Guidelines play a crucial role in the international harmonization of the application of the Codex system.

HAZARD ANALYSIS AND CRITICAL CONTROL POINTS

HACCP is a systematic preventive approach to food safety, pharmaceutical safety, etc. that addresses physical, chemical and biological hazards as part of prevention rather than finished product inspection and the HACCP system is a main feature in the new European food law laid down in the Regulation (EC) 852/2004. HACCP is used in the food industry to identify potential food hazards, so that key actions, known as Critical Control Points (CCPs) can be taken to reduce or eliminate the risk of the hazards. The system is used at all stages of food production and preparation processes. In 1994, the organization of International HACCP Alliance was established initially for the US meat and poultry industries. HACCP is obligated since 2003 in Slovenia and is now integrated in all food industry as well as in catering and stores. HACCP is a systematic approach to the identification, evaluation, and control of food safety hazards based on the following seven principles: Analyse hazards, identify critical control points, establish preventive measures with critical limits for each control point, establish procedures to monitor the critical control points, establish corrective actions to be taken when monitoring shows that a critical limit has not been met, establish procedures to verify that the system is working properly, establish effective record keeping to document the HACCP system. It is not the matter of high technology equipment or high performance analysis. Each of these principles must be confirmed by scientific knowledge: for example, published microbiological studies on time and temperature factors for controlling foodborne pathogens. In principle when the HACCP is establishing in manufacture there is a lot of paper work that should be done, but when is implemented is it very useful tool to manage the whole process. Sometimes only after HACCP is established we notice some bad habits in production process that represent unnecessary hazard that can be eliminated with low costs.

GOOD MANUFACTURING PRACTICE

Good Manufacturing Practice (GMP) is defined as the part of Quality Assurance (QA) that ensures that products are consistently produced and controlled to the quality standards appropriate to their intended use. Howsoever, food is an area of commercial interest therefore is it important to assure enough safe and quality food. Food Safety has been discussed in various ways in various societies. In recent years because of increased commercialisation and adoption of unhygienic habits for undue commercial gains and lack of resources available to the people, food hygiene has become a major issue of international trade. Food safety has become an issue of great interest to everyone in food trade when the United States Pathogen Reduction / HACCP rule published in July 1996 combines the concepts of HACCP systems with the requirement for written Sanitation Standard Operating Procedures (SSOPs). However, HACCP and SSOPs are only part of a total food safety system. GMP provides the foundation for SSOPs and HACCP. It is important to have a clear understanding of the relationship between the GMPs, SSOPs and HACCP plans for compliance of various food safety regulations. GMPs pre-requisite programmes comprise the basic, universal steps and procedures that control operating conditions within establishments and ensure favourable conditions for the production of safe food. These differ from HACCP systems, which focus on the critical points in a manufacturing process that affects food safety. GMPs are the control factors that relate to the entire operation and are not process-specific. GMPs include programmes such as facilities/grounds, equipments/utensils, pest control, receiving and storage, process control, product recall and personnel training. GMPs are like any policy programmes those describing good habits, which leads to sufficient result, also for non-food manufactures. They require a written programme, an appropriate training programme and schedule, maintenance schedule and most importantly management commitment. Management commitment is the vital component of any programmes the company implements. Management's role takes on many forms from providing funds, guidance, and human resources, to following the rules themselves. Once management has committed to the implementation of a programme other components will fall in place. Without this no amount of investment or external assistance will deliver results. The written programme will serve as the base for other components. A good written programme includes who, what, where, when and why. It should clearly explain the scope of the programme, responsible

individuals, its importance, parameters, monitoring activities and records, corrective actions and records and also verification activities. The written programme should be written at a level that is appropriate for the educational level of employees and in a language they understand. GMP and other GPs are assuring foundation for good quality of HACCP system. Therefore effective and holistic GMP is pre condition for all other steps in Food safety process.

TRAINING OF PERSONNEL, CLEANING AND DISINFECTION, PROTECTING CLOTHING AND PERSONAL HYGIENE

Disinfectants have a highly diverse regulatory status: At the moment a common approval system for disinfectants used in food industry is being built up; now there is a approval system only for some food e.g. milk but not for others e.g. meat. Thus there is specific legislation depending of the type of production or consumption. Disinfection procedure is of good quality should be based on environmental conditions, microbial agent susceptibility, type of facility, choice of cleaning and disinfectant products, cleaning and disinfection supply need, type of surface areas to be cleaned, staff in charge of these activities, cost of these operations.

Training of personnel: Good worker health and hygiene is critical for preventing foodborne illnesses. The first step towards good worker health and hygiene practices is first hand knowledge of how foodborne illnesses and other infectious diseases spread. The second step is to know how to contain or limit the spread of foodborne diseases by practicing scientifically known intervention techniques e.g. hand washing. Here are some of the simple steps that the operators or managers can take to help prevent the spread of foodborne illnesses. Training and orientation on the basic principles of health and hygiene, hand washing techniques, and recognizing foodborne illness symptoms can help workers understand their role in disease prevention. An adequate number of hand washing units and toilet facilities should be available. Hand washing units should be fully stocked and easily accessible, and no more than a few minutes walk from where any employee is working. Instructions for proper use of them should be prominently posted. As a general rule, one facility is required for every 20 employees. Provide a clean area designated for employees to eat, drink, and use tobacco. Lockers or other suitable facilities to accommodate employee's personal belongings should also be provided. When disposable gloves are provided for

employees, the employees must be trained to use gloves properly. Even though hand sanitizers can be used, they are by no means a replacement to proper hand washing. Should a hand sanitizer be part of an operation, it needs to be one already approved by the Food and Drug Administration (FDA).

Cleaning and disinfection methods: Cleaning is the complete removal of food soil using appropriate detergent chemicals under recommended conditions. It is important that personnel involved have a working understanding of the nature of the different types of food soil and the chemistry of its removal. Cleaning frequency must be clearly defined for each process line i.e. daily, after production runs, or more often, if necessary. The type of cleaning required must also be identified. Sanitizing procedures must be evaluated for adequacy through evaluation and inspection procedures. Adherence to prescribed written procedures (inspection, swab testing, direct observation of personnel) should be continuously monitored, and records maintained to evaluate long-term compliance. Equipment can be categorized with regard to cleaning method as follows: Mechanical Cleaning is often referred to as clean in place (CIP). Require no disassembly or partial disassembly. Clean-out-of-Place (COP) can be partially disassembled and cleaned in specialized COP pressure tanks. Manual cleaning requires total disassembly for cleaning and inspection. It is important to differentiate and define certain terminology: Disinfection or sanitation refers to the reduction of micro-organisms to levels considered safe from a public health viewpoint. *Thermal Sanitization* involves the use of hot water or steam for a specified temperature and contact time. *Chemical Sanitization* i.e. disinfection involves the use of an approved chemical sanitizer at a specified concentration and contact time.

Protecting clothing and personal hygiene: When we are talking about protecting clothing we usually mean equipment that protects employees either than food from contamination. Use of protecting clothing is depending on many different aspects. First of all is necessary to know what we would like to achieve by using it. Is it only matter of satisfying the EC 852/2004 on the hygiene of foodstuff, or we would like to achieve another dimension of quality and worker's perception? All companies have on some way assured even just the presence of protecting clothing on work place. But unfortunately this is not enough to reach the goal of hygiene. Quality and serviceability of clothing cannot obviously lead us on higher level of hygiene in production. Sometimes in reality we can recognized that use of protecting clothing (like gloves and masks) could be source

of contamination while incorrect using. Employees have to be well educated and also trained how, when and why to use protecting clothing. Type of clothes depends on process e.g. high humidity and temperature and low temperature with high ventilation as well as origin of raw materials. SMS enterprises, which are the most presented in Slovenia, are common to use outsourcing in case of protecting clothing. An intact glove provides adequate protection from microbial transmission of hand-contaminating micro-organisms. However, some food-grade gloves may have existing pinhole punctures and/or can be easily ripped, torn, or punctured during use. While hand washing, on the other hand, can be very effective in removing micro-organisms, ensuring that food workers perform effective hand washes is difficult. Thus, the studies recommends donning of gloves to be preceded by an effective hand wash, ongoing employee training and education, high personal hygiene requirements, and institution of a quality control. Further, to reduce disease transmission by contaminated objects, the study suggests an effective environmental and sanitation program and restriction of tasks among workers to prevent contamination. Foreign objects e.g. glass, sand and stones can be broadly classified as food safety hazards and food non-safety hazards e.g. incorrect allergen free filling. Foreign objects that are physical hazards are referred to as hard or sharp objects and also some parts of clothing. Hard or sharp objects are further divided into metallic objects, which are divided into ferrous and non-ferrous metals, and non-metallic objects. Controls for metal inclusion can include periodic checks of metal equipment and passing the product through metal detectors or separation equipment. To achieve high level of hygiene the effective training is essential. Sometimes a language can be a barrier because of heterogeneous nationality of employees with low or none education. A picture and symbol based approach can be an affordable and effective solution. Experts can be helpful in motivating employees to comply with fundamental sanitation principles. Overall, numerous technologies are available to sanitize a plant, but they are only effective if supported by plant employees.

QUALITY STANDARDS

Food safety is linked to the presence of food-borne hazards in food at the point of consumption. Since food safety hazards can occur at any stage in the food chain it is essential that adequate control be in place. Therefore, a combined effort of all parties through the food chain is required. For this reasons many different food standards have been developed. On the other hand ISO 9001 is

standard for quality management (QM) systems for different types of production or business. The so called 'food standards' are standards for managing quality and food safety in food business or in whole food chain. **ISO 9001:2000** is maintained by the International Organization for Standardization (ISO) and is administered by accreditation and certification bodies. ISO 9001:2000 specifies requirements for a QM system where an organization needs to demonstrate its ability to consistently provide product that meets customer and applicable regulatory requirements, and aims to enhance customer satisfaction through the effective application of the system. These include processes for continual improvement of the system and the assurance of conformity to customer and applicable regulatory requirements. All requirements of International Standard are generic and are intended to be applicable to all organizations, regardless of type, size and product provided. **ISO 22000:2005** is an internationally recognized standard intended to harmonize on a global level the requirements for food safety management within the food chain. It has been designed to be compatible with other management system standards such as ISO 9001 and can be implemented within an integrated management system. The standard combines the key elements to enable management of food safety along the food chain including: integrating the principles of HACCP and application steps developed by Codex Alimentarius Commission; system management; control of food safety hazards through pre-requisite programmes and HACCP plans; interactive communication with suppliers, customers, regulators, consumers; continual improvement and updating of the management system. The **British Retail Consortium (BRC) Standard** was created to establish a standard for the supply of food products and to act as key piece of evidence for UK retailers and brand owners to demonstrate 'due diligence' (taking all reasonable precautions to prevent an unsafe or illegal product causing customer illness or injury) in the face of potential prosecution by the enforcement authorities. Certification to the BRC standard verifies technical competence and aids manufacturers, brand owners and retailers fulfilment of legal obligations. It also safeguards the consumer. This standard possesses a comprehensive scope covering all areas of product safety and legality, addresses part of the due diligence requirements of both the supplier and the retailer. It covers such critical topics as: HACCP system, QM, factory environment standard, and product and process control.

METHODS USED FOR MONITORING MICROBIAL CONTAMINATION OF BAKERY PRODUCTS AND BEVERAGES IN ESTONIA, SLOVENIA AND TURKEY

The following is the range of in that produced by beverage industries carbonated soft drinks, cordials and concentrates, energy drinks, fruit juice and fruit drinks, functional non-alcoholic drinks, iced teas and coffees, mineral, spring and packaged waters sports and isotonic drinks. Sampling is one of the most important parts, when detecting microbial contamination inside the plant. Samples should be taken throughout the production from raw materials to final products. Frequencies, where and when the sample must be taken and what kind of analysis is done, is part of HACCP plan, which is made according to general recommendations for certain type of production and also specific conditions in the plant. Only trained personnel from quality control department or production department, which are able to take the samples correctly, should perform sampling. All analysis in national labs is done according to ISO standards. National legislation prescribes them analysis for control of bottled drinking water. When analysing soft drinks and beer, national labs use guidelines issued by the National Health Institute and specifications given by the producers themselves.

METHODS USED FOR BAKERY PRODUCTS AND BEVERAGES IN ESTONIA

In Estonia the food sphere-handling of raw materials for food and feed, the Food Act and Directive of the EP and the EC 178/2002 EEC regulate self-control of food handling operator and governmental food control. As provided by the Food Act, the Veterinary and Food Board (VFB), the Estonian Consumer Protection Board and the Estonian Tax and Customs Board perform food control. The Veterinary and Food Board is to perform supervision of all the spheres of handling and materials and items, specified in Article 1 (2) of the Regulation of the European Parliament and the European Council No. 35/2004/EC. In performing the food analyses VFB uses the services of the Estonian Veterinary and Food Laboratories (VAFL). At the same time VAFL operates as a reference laboratory. The internationally certified Estonian Accreditation Centre accredits VAFL in the area of food and drinking water testing in accordance with EVS-EN ISO/IEC 17025 ON “General requirements for the competence of testing and calibration laboratories”. Performing the tests laboratories use the latest valid

editions of an international approved standards (ISO, NMKL). The most common microbiological spoilage problem in bakeries is related with moulding. Mycotoxigenic moulds can be isolated from spoiled breads, and many mycotoxins have been produced in inoculated breads, but surveys of naturally mouldy breads have yielded only aflatoxins and ochratoxin A in a few samples (Legan, 2002). Furthermore, several bakery products also hare been implicated in foodborne illnesses involving *Salmonella* spp., *Listeria monoctyogenes* and *Bacillus cereus*, while *Clostridium botulinum* is a concern in high moisture bakery products packaged under modified atmospheres (Smith *et al*., 2005). To decrease the risk coming from microbiological spoilage, all bakeries have own-checking plan (OCP) or HACCP. An effective HACCP programme requires equally competent technologies to determine and monitor each critical point (Barendsz, 1998). The exact microbiological sampling plan is set with the OCP or HACCP. One of the easiest ways to analyse microbiological spoilage from environmental samples including equipment and utensils and also from employees' hands and clothes is to use Hygicult® contact slides. There are different types of Hygicult® tests, but most common in bakeries are Hygicult® TPC for total bacterial count and Hygicult® Y&F for yeasts and moulds. Both tests are easy to use; Hygicult® slides are intended for rapid monitoring of microbiological hygiene in different types of materials, both solid and liquid. Most food productions do not analyse pathogens from their product by themselves; very often all tests for final product and water are performed in accredited laboratories. Drinking water quality is one of Estonia's priorities. The requirements of Council Directive 98/83/EU are established in Estonian law in the Public Health Act, the Water Act, and regulations passed implementation (http://www.euro.who.int/eehc/implementation/20061010_6). One of the ingredients in bakery products and beverages is water, every plant have to analyze drinking water for *Escherichia coli* (limit 0 CFU/100 ml) and enterococci (limit 0 CFU/100 ml) with frequency according to the OCP/HACCP (Anon., 2007c). Beverage productions that produce still and carbonated water have to follow microbiological limits according to Estonian law, Joogivee kvaliteedi- ja kontrollinõuded ning analüüsimeetodid (Act 82, RTL 2001, 100, 1369). Water filled to the bottles must follow microbiological limits given below: *E. coli* – 0 CFU/250 ml, enterococci – 0 CFU/250 ml, *Pseudomonas aeruginosa* – 0 CFU/250 ml, colonies at 22 °C – 100 CFU/ml, colonies at 37 °C – 20 CFU/ml (Anon., 2002). According to Estonian law ISO 9308-1 method is used for analyzing *E. coli* and coliforms, ISO 7899-2 for enterococci, EN ISO

6222 for colonies at 22 °C and 37 °C, EN 26461-2:1993 for *C. perfringens* (including endospores) and prEN ISO 12780 is used for analysing *P. aeruginosa* from drinking water (Anon., 2007b). The frequency of microbiological test for final product in bakeries is set with OCP/HACCP, but it can be 1–2 times in a year. *E. coli*, *Staphylococcus aureus*, total bacterial count, moulds and *B. cereus* can be analyzed depending on ingredients of product. ISO 16649-2 is used for analyzing *E. coli*, EVS-ISO 699-1 for *S. aureus*, NMKL nr. 86, for total bacterial count, EVS/ISO 7954 for moulds, NMKL nr. 67 for *B. cereus*. Microbiological criteria for raw material and food have set in Commission Regulation (EC) No 2073/2005 of 15 November 2005.

METHODS USED FOR BAKERY PRODUCTS AND BEVERAGES IN SLOVENIA

In bakeries the most important part of the monitoring microbial contamination in food industry is sampling. In bakeries raw materials and the end products are monitored. All sampling must be performed according to HACCP plan by trained quality control department personal. In HACCP plan frequency of sampling raw materials and end products, what kind of analysis we do on sample, which parameters must be taken in consideration and all precaution measures in case of detecting the potential pathogenic or spoilage micro-organisms in sample are established. In the process of monitoring to detect potential pathogenic micro-organisms and to detect spoilage micro-organisms are essential. Potential pathogenic micro-organisms usually cannot cause serious health problems to end consumers whereas the spoilage micro-organisms usually cannot cause health risk, but can have serious financial effect on producer. In bakery the most frequent spoilage micro-organisms on end products are yeast and moulds whereas on raw materials are the spore forming micro-organisms e.g. *B. cereus, B. subtilis* and moulds, which can survive baking. In industrial laboratory for testing our raw materials and end products we use ISO methods and also methods used in study laboratories on faculties, which are validated on ISO methods. We established the criteria for acceptable or unacceptable raw material or end product from microbiological point of view. The criteria are based on national guidelines for microbiological safety of foods for human consumption and on Croatian National legislation for microbiological standards for foods for human consumption. Our main raw material is flour and for flour is important that the number of spore forming micro-organisms is in accordance with our criteria and from that kind of raw materials we can bake the end

products of good quality. In national-accredited laboratory for testing the food samples ISO methods are used. Some methods, which they use, are not ISO methods, but all non-ISO methods are validated according to the ISO 16140:2003. Monitoring of bottled drinking water is done according to national legislation, which requires absence of *E. coli, P. aeruginosa* and faecal enterococci in 250 ml. There is no spoilage micro-organisms related to bottled water. On the other hand, by production of soft drinks and beer, spoilage micro-organisms are the main targets of detection, since pathogens are highly unlikely to be found in these products due to the processing steps e.g. pasteurisation and filtration and their characteristics e.g. low pH and carbon dioxide (CO_2) content. Main spoilage micro-organisms of cold aseptic filled soft drinks without conservation are moulds, yeasts, lactic-acid bacteria and recently also thermophilic spore forming bacteria of genus *Alicyclobacillus*. The main spoilage micro-organisms of beer are lactic-acid bacteria e.g. *Lactobacillus* spp. and *Pediococcus* spp., obligate anaerobe *Pectinatus* spp. and non-cultivable (wild) yeasts. Guidelines for beer recommend detection of yeasts in pasteurised beer and detection of *Salmonella* spp., *Enterobacteriaceae* and yeasts in unpasteurised beer. For soft drinks with pH <4.2 they recommend detection of yeasts, moulds and *Enterobacteriaceae.*

METHODS USED FOR BAKERY PRODUCTS AND BEVERAGES IN TURKEY

Evaluation of microbial contamination of indoor air, critical areas in the plant, equipment etc. is essential to ensure standard quality and safety of food. The HACCP puts strong emphasis on the importance of microbiological analysis of food products and sterility audits of manufacturing processes and facilities. In Turkey, the samples are taken by trained personnel from quality control department according to general recommendations of standard methods for certain type of productions and also specific conditions in the plant. Certain microbiological test procedures of all foods are done according to ISO standards, EC Decision 2001/471/EC including the HACCP principles and the national legislation (Turkish Food Codex Regulation) in national laboratories. A general sterility and sanitation audit includes following specific microbiological tests Heterotrophic Plate Count/Mould and Yeast: Detection/Identification (FDA/BAM: 2001), Total Coliforms/Faecal Coliforms (FDA/BAM: 2002), *E. coli/ E. coli* 0157:H7 (FDA/BAM: 2002, BAX System Q7), *Salmonella* spp. (ISO 6579: 2002, BAX System Q7), *Listeria monocytogenes* (Oxoid Listeria

Rapid Test, API Kit, BAX System Q7), *Listeria* spp. (Oxoid Listeria Rapid Test), *Clostridium perfringens* (FDA/BAM: 2001), *Staphylococcus aureus* (FDA/BAM: 2001), Mesophilic aerobic spore formers (FDA/BAM:2001), Mesophilic anaerobic spore formers (FDA/BAM: 2001), *B. cereus* (FDA/BAM: 2001), Rope spore (FDA/BAM: 2001), Mycotoxins (AOAC 999.07:2000, TS EN ISO 14501:2002) for bakery products.

The microbiological analysis of the spring and drinking water are done with membrane filtration method according to ISO standards and Turkish Standard (TS 266, Regulation Concerning Water Intended for Human Consumption) the standardization of Turkey which requires absence of coliform/faecal coliform bacteria, *E. coli, P. aeruginosa* and faecal enterococci in 250 ml, and *Salmonella spp*. in 100 ml, *C. perfringens* in 50 ml. Main spoilage micro-organisms of fermented beverages are lactic-acid bacteria and the thermophilic acidophilic spore-forming bacteria *Alicyclobacillus*. No effective control methods have yet been developed for *Alicyclobacillus.* They can grow at low pH and at moderately high temperatures such as 40 °C are known to cause spoilage of acidic beverages and produce odours. However, they do not produce gas or cause any change in the appearance of the beverage container, and therefore the spoilage is discovered only when the consumer opens and begins to consume the product. Turkish Food Codex Regulation for fermented beverages recommends the detection of mesophilic aerobic bacteria, acidophilic bacteria and mould/yeasts in fermented beverages. The Ministry of Agriculture and Rural Affairs (MARA) is responsible for the implementation of the legislative framework and carry out the food inspection in Turkey. The MARA, through its General Directorate of Protection and Control carries out the food control from farm to sales point. It also performs the food control at retailing and consumption points. Under the umbrella of the General Directorate of Protection and Control of MARA there are 81 Provincial Directorates, 39 Provincial Control Laboratories and one Food Control and Research Institute. Kalite Sistem Laboratories Group is an accredited entity that is the largest private industrial research, testing, inspection and training organization in Turkey. Kalite Sistem Authorized Food Control Laboratories have the authorization and accreditation from both the Ministry of Health and the MARA for analysis of the imported and exported foods and market inspection in the food sector. Kalite Sistem Central Laboratories, which was accredited by TSI according to ISO 17025 and affiliated to the AGES (Austrian Agency of Health and Food Safety – Österreichische Agentur für

Gesundheit und Ernährungssicherheit), performs analysis in food, feed, cosmetics, medicine, detergent and cleaning chemicals. ISO 22000, BRC, IFS, EUREPGAP, ISO 9001 certifications Turkey's basic mission is provide international recognition, food safety/quality also consumer assurance and law requirement for their brand. Laboratories performed the tests and analysis through international reference methods verified by validation studies (AOAC, AOAC, APHA, FAO and EEC). The reliability of the analysis results is regularly controlled and monitored by proficiency testing studies, ring tests, inter-laboratory comparison studies and certified reference materials.

FUTURE NEEDS

Food- and waterborne illnesses cause not only hospitalization cases which might result with death but also serious economical losses due to the hospitalization cost and product losses. In the food industry, the main goal is to produce better quality and safer products with microbial load as low as possible. In this sense, safety and quality legislations have been improved to overcome these problems. Numerous research articles have being published on new rapid and reliable microbiological techniques; however such techniques are not cheap and easy to use for on-plant applications. Conventional techniques have been still preferred in terms of cost by companies. To our common opinion, air and environmental borne microbial risk threat bakery and beverage plants. Biosensor-based sensitive techniques that produce quick results could be designed for microbial detection. Collaboration between universities or research laboratories and food companies has been limited until now. Effective and utilizable up-to-date techniques and technologies developed in research labs must be transferred to plant. In addition, companies in view of feedback tested in work place could support new researches to scale up the prototypes. Companies' demands must be determined and projects in view of these needs must be proposed to academia. Researchers must concentrate on novel projects, which produce solutions to the problems of companies. Moreover, trained personnel can be employed in critical part of operation. EU and national authorities require Microbiological Criteria for all types of food products. There is no common microbiological analysis technique covering all types of food products including functional foods. Moreover, analyses techniques among the countries and between industrial and research laboratories are not compatible. As a result, reliable, cheap, sensitive, easy and rapid microbiological analyses techniques and procedures that are

generally acceptable in all laboratories of EU countries must be revised. RA is a sensitive issue, which requires multidisciplinary teamwork. Therefore, cooperation among governments, companies and scientists is unavoidable to set up common rules. The hygiene package includes European Parliament and Council Regulations 852/2004, 853/2004, 854/2004 and 882/2004, requiring demonstration of wholesomeness of foods manufactured and distributed according to HACCP-based Good Practices, would ideally call for standardized European methods to assess compliance with respect to microbiology. For cultural reasons this goal does not seem within reach in the near future. While, admittedly different though nonetheless excellent, method collections are available, a pressing need was identified to assess whether such different methods produce roughly equivalent results with respect to accuracy, repeatability and reproducibility.

CONCLUSIONS

RA is the science-based component of risk analysis. Over the past decade, risk analysis has emerged as a structured model for improving food control systems with the objectives of producing safer food; cutting the numbers of foodborne illnesses and facilitating domestic and international trade in food. The classical RA approach is considered to carry out at the governmental level. RA should be carried out at company level. Also, during the RA process the dose-response model should be realized at the company level. On the other hand, it is well known from the relationship between the food industry, health surveillance (food safety monitoring systems) and the food inspection bodies that the barrier of RA carried out at the governmental level often is the lack of data obtained from the industry. In order to provide more precise estimates, industry, governmental agencies and scientific institutes must work together to enable the required progress of RA. Although the technology of bakery and beverage manufacturing has rapidly developed and progressed in the past decades, the ultimate goal is still to operate at low cost and implement aseptic technologies. Despite the advanced technology, spoilage of bakery or beverage products as well as detection of indicator micro-organisms in the process continues to occur. The scope of this study is to addresses microbiological RA, based on process exposure assessment versus finished-product microbiological quality control proved to be a very powerful tool. It provides added value to the bakery and

beverage industry, with a special focus on business risk reduction parallel to ensuring food safety, as the most important quality parameter.

Further Reading:

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