DOI: 10.54597/mate.0064
Srečec, S. (2022): Quality assurance in agri-food chains.
In: Srečec, S., Csonka A., Koponicsné Györke, D., Nagy M. Z. (Eds.):
Management of agri-food chains. Gödöllő: MATE Press, 2022. pp. 80–95..
(ISBN 978-963-623-023-4)

CHAPTER 6

Quality assurance in agri-food chains

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6.1 Introduction

As already mentioned, food quality is not easy to define and there is no single definition of food quality, which would be comprehensive and contain all the elements of the definition.[1] Therefore, food quality is assessed on the basis of attributes or properties of food quality in each agri-food chain. In general, quality consists of eight basic dimensions[1], which are:

1. execution
2. features (attributes)
3. reliability
4. compliance
5. durability
6. possibility of servicing
7. aesthetics
8. proven quality.[2]

Of course, the 6th dimension of quality, *'serviceability'*, is not applicable to the quality of food, *ie food products*, so it is replaced in the agri-food chain by *traceability*[2] and *improvements* (cf. Chapter 6.2). However, every performance of a food product must be flawless. Namely, the case of any poor performance of a food product can endanger the health of consumers.[3] *Features or attributes* of food quality are discussed in detail in ch. 4. *The reliability* of any food product is the result of its good performance and it is a consequence of *good external and internal attributes of quality* and its performance. *Conformity* of food products unlike other products implies compliance with the nutritional needs and expectations of consumers (both in nutritional and safety terms), but also compliance with the standards prescribed by food legislation. *The durability* of food products is an extremely important property of quality. This primarily means the shelf life under appropriate storage conditions. *The aesthetics* of each product is extremely important for the visual perception

[1] *cf.* ch. 4. Attributes of food quality and sources of danger in agri-food chains.
[2] *cf.* ch. 1. Agricultural food chains → 1.6. Traceability in the agri-food chain
[3] *cf.* ch. 4.3. Sources of danger in agri-food chains

of consumers. However, when it comes to food products, aesthetic qualities are manifested at the level of packaging design and at the level of food product appearance. The notion of *proven quality* of a food product appears on three levels. At the level of actual evidence the declaration of the product with the specified control body or accredited laboratory that conducted the appropriate analyzes should be stated, at the level of clearly visible markings on the packaging of the food product on the quality control system (eg HACCP, Halal, Kosher, GGN) and personal perceptions of consumers who identify the quality of a product with its geographical origin (eg Croatian quality brand, or Italian pasta or wines with a certain geographical origin, etc.). Often even the very name of a manufacturer's company is identified by consumers of a particular food product with the quality of that product.

In any case, in order for the quality of an agricultural and/or food product to be manifested in all eight dimensions of quality[1, 2], it is necessary to design and implement the most appropriate and efficient quality assurance and management system in the entire agri-food chain.

6.2. Differences between managerial and technological approach in quality management in agri-food chains

Food quality management includes food quality with all its properties or quality attributes and overall quality management[3]. In order to achieve the most efficient food quality management in any agri-food chain, it is necessary to establish a food quality management system according to a methodology that combines technological and managerial approach to quality management[4]. The basic engine of any quality assurance and management process in any industry is the *b* or *PDCA cycle*[5]. It is known that the PDCA cycle or Deming quality cycle consists of four phases that continue on top of each other and never end, at least not as long as there is a specific organization and/or specific product/production. These phases are known as: Plan – Do – Check – Act.

In particular, the *planning phase – for technologists* – involves the design of a particular food product, its safety for consumer health, nutritional value and sensory properties and the organization of its production. *For management,* the planning phase means increasing sales, increasing cost efficiency, increasing profits. Sometimes the views of technologists and company managers are conflicting. For example, if in the opinion of technologists certain changes need to be introduced in the technological process, which certainly requires investment, and the key indicator of business efficiency of management is cost efficiency (known as 'cost cutting'), then there is inevitably a conflict between the two sides in the project team. Therefore, it is necessary to answer three basic questions before starting the PDCA cycle:

1. What improvements are needed?
2. What changes are needed to make improvements?
3. What are the measurable indicators to determine that the implemented changes have led to improvement?

Only when the members of the quality assurance and management team agree on their answers to these three questions can an appropriate decision be made to plan certain changes regardless of their nature, whether it is designing a new product or investing in irder to reduce losses and generate savings in the production process[6], or about any other change that is supposed to lead to the necessary improvements.

The question arises; – How is it possible that in an organization dedicated to food production there may be differences in defining priorities in determining the necessary improvements and changes in the process that lead to them?

The answer is; – Because there are groups that have different approaches to economics, which is often conditioned by differences in worldview.

Namely, according to one definition, economics is the science and skill of how to use scarce resources (money, but also natural and human resources) to produce and distribute new goods and services that will meet the needs of those for whom they are intended and those who create them[7]. However, there are generally two different approaches in economics, namely normative economics and positive economics[8]. Norma-

tive economics aims to determine what should happen or what should happen. It is often determined by worldview (and even ideological) attitudes, and unfortunately sometimes by prejudice. Positive economics, on the other hand, relies on facts, that is, on what is happening.

It should be noted that supporters of both normative and positive economics are represented both among technologists and in management. This is very well illustrated by the two most common statements that can very often be heard in a conversation:

1. "We can produce anything we want, there are essentially no technological limitations."
2. "They want everything to be over yesterday, and they never provide the necessary budget for the necessary investments."

The first statement is typical for managers who will focus their improvement measures on changing the organizational structure, developing procedures, improving the level of knowledge through various workshops, trainings, consultations and removing responsible persons from certain positions (although there are no real reasons), etc.

The second statement is characteristic of technologists who will propose the purchase of new machines, improvements in the technological process, the introduction of more sophisticated analyzes, educating employees about biochemical processes, etc.

That is why it is extremely important to integrate these two opposing attitudes into the techno-managerial approach[9].

In quality assurance in the agri-food chain, the techno-managerial approach includes:

- Knowledge of hazards; biological, chemical and physical.
- Sampling and analysis; raw materials, semi-finished products, finished products, products in stock and on shelves, as well as market research, ie target groups of consumers and competition.
- Knowledge of changes in food properties in the agri-food chain; in primary production, post-harvest storage, processing, food storage, distribution.
- Decision making; based on the analysis and synthesis of data collected under the previously listed points.
- Evaluation and confirmation of the efficiency of the quality assurance and management system, including safety management from the aspect of hygienic and health safety of food products[10].
- Development of quality culture; that is, an adequate model of *quality behavior* that will unite all the elements listed under the previous points.

Everything needed to achieve a techno-managerial approach to quality assurance in the agri-food chain is contained in *fourteen Deming*[4] *points*[11, 12, 13]:

1. Create a statement to all employees of the goals and purposes of the company or other organization. Management must constantly demonstrate its commitment to this statement through its actions and behavior.
2. Adopt a new philosophy, from top management to each employee.
3. Understand that the purpose of inspection (syn. Verification) is to improve the process and reduce costs.
4. Abandon the practice of awarding jobs only on the basis of price.
5. Constantly and always improve the system of production and services.
6. Institutional training.
7. Teach and establish leadership.
8. Remove fear. Establish trust. Establish an innovation climate.
9. Optimize the efforts of teams and groups according to the goals and purpose of the company.
10. Remove constant reprimands in the workplace.

[4] Dr. W. Edwards Deming (1900-1993) was a professor at the Massachusetts Institute of Technology (MIT). He developed a number of sampling techniques to improve labor statistics. He was a world-renowned management and quality consultant. United States President Ronald Reagan awarded him the 1987 National Medal of Technology and Innovation.

11. a) Abandon production quotas and learn and introduce methods of improvement instead
12. b) Leave M.B.O.[5] instead develop employees' knowledge of processes and how to improve them.
13. Remove barriers that take away people's pride in making.
14. Encourage education and personal development for everyone.
15. Take action to bring about transformation.

The main tools applied in the techno-managerial approach to quality assurance in the agri-food chain are *communication, analytics and statistics.*

6.3 Steps of the risk management process in the agri-food chain

When we talk about risk management in the agri-food chain (s), we mean *the risks related to the hygienic and health safety of agricultural and food products* for human and animal health. Therefore, risk management in agri-food chains refers exclusively to the assessment, monitoring and control of chemical, physical and biological hazards in agri-food chains.[6]

The first, ultimate and basic step in risk management in agri-food chains is RISK ASSESSMENT(!). The second step is RISK MANAGEMENT.

6.3.1 Risk evaluation

Risk assessment in the agri-food chain also has its epidemiological significance[14]. Namely, epidemiology is not only focused on disease research, but it is a holistic science in which economics, management, natural sciences and sociology are united in a common field of *public health*. So it should come as no surprise that a large number of acute, but also chronic, diseases are associated with the consumption of certain foods.[7] Numerous food allergies are known[15], but also chronic food poisonings that cause genotoxicity and lead not only to the appearance of carcinogenic diseases, but also to deformities in the offspring[16, 17]. However, how can we conduct a risk analysis of any of the harmful agents in the agri-food chain or some other factor that may affect some other properties of food quality?

Risk assessment is performed through the following stages:

Phase I
Draw a flow diagram of the agri-food chain for a particular product. Only by knowing all the details of production, procurement, logistics and distribution is it possible to assess the possibility of the risk of contamination by some of the harmful agents. Moreover, an accurate process flow diagram allows the detection and causes of errors in production, distribution and transport that have led to spoilage or reduction in the quality of a food product. *Therefore, the flow diagram of all processes, in each agri-food chain, must be clear and accurate(!).*

Phase II
After making a detailed flow chart of the process, and if possible, in parallel with its development, make a *decision tree.* However, in practice, many times (unfortunately even *too often*) the decision tree is made in a template, ie without taking into account the details of the flow diagram of the process in the agricultural production chain. Namely, the decision tree method was developed in the United States in the mid-1960s[18]

[5] M.B.O. Management by Objectives - Management by Objectives is a strategic management model that aims to improve organizational performance by clearly defining objectives that both management and employees agree on. Critics of the MBO argue that this leads employees to try to achieve their goals by all necessary means, often at the cost of the company or organization itself.

[6] *Cf.* Chap. 4. Attributes of food quality and sources of danger in agri-food chains → 4.3. Sources of danger in agri-food chains → 4.3.1. Sources of biological hazards in the agri-food chain

[7] *Op.* in English there is a clear term *food-born disease (s).*

and is applicable in almost all decision-making processes, from intelligence and criminology to the determination of control and critical control points in industrial processes. The term *control point (CP)* is an exact place in the process where the control of a certain factor (factor) that can adversely affect the correctness and safety of any product. By sampling and analyzing the sampled material, this factor is brought under control. The term *critical control point (CCP)* is also a place in the process where control of a certain factor is carried out, but unlike a control point, *at that place this factor is not completely under control because its negative effects can not be determined by standard analyzes and procedures. Their presence above the allowed limits is proven only by additional analyzes or methods*[19]. Questionnaires are already in place today to create a decision tree, and most often, during an interview with an employee of an organization / company, quality auditors will conclude based on their answers whether it is a control or critical control point at a certain stage of the process. In most cases, the assessment of critical control points corresponds to the real situation. However, often times it doesn't, or at least not completely. Therefore, it is necessary to check the credibility of the decision tree.

Phase III

The most effective way to verify the credibility of the decision tree is to apply the *method of Failure Modes and Effects Analysis (FMEA)*[20]. The method is objective because it uses the *Risk Priority Number (RPN)* to determine the risk priority (Equation 1).

$$RPN = S \times P \times D \quad (1)$$

Where is:

RPN – Risk Priority Number

S – represents the severity or importance of negative effects (errors or defects)

P – represents the probability of negative effects (errors or defects)

D – represents the ease of detecting negative effects (errors or defects).

In doing so, the values of severity (*S*), probability (*P*) and ease of detecting errors or defects (*D*) that occur when a particular factor is not under control are determined by the criteria listed in Tables 1, 2 and 3[20].

Table 1. *Performance severity ranking*[20]

Effect	Severity of effect	Severity factor
Danger without warning	Very highly ranked with possible outcome of errors or other negative effects. Affects safety and non-compliance. Adverse effects occur without warning.	10
Danger with warning	Very highly ranked with possible mode of error. Affects safety and non-compliance. An error occurs with a warning.	9
Very tall	Dangerous. The product becomes unusable.	8
High	The product is usable but with the loss of some quality properties. The customer is not satisfied.	7
Mediocre	The product is usable but with the loss of certain benefits. The customer feels uncomfortable.	6
Low	The product is used but with the loss of certain benefits to the extent that the customer feels some discomfort.	5
Very low	Certain product quality properties do not meet specifications, but have been discovered by most customers	4
Low	Certain product quality properties do not meet specifications, but have been discovered by average customers	3
Very low	Certain product quality properties do not meet the specifications, which they found.	2
No	No negative effects	1

Equation 1 includes the values of the severity factors for the severity of the effects (Table 1), and for the probability of occurrence and the ease of detecting errors in the values of the corresponding ranks (Tables 2 and 3).

Table 2. *Ranking the probability of occurrence*

Probability of occurrence	Explanation	Possible error rate *	Rank
Very high	A complete failure of the process	> 1 in 2 products	10
		1 in 3 products	9
Tall	Associated with processes similar to the previous ones that often failed	1 in 8	8
		1 in 20	7
Central	Associated with processes similar to previous processes that have experienced occasional failures or errors	1 in 80	6
		1 in 400	5
		1 in 2000	4
Low	Isolated errors associated with similar processes	1 in 15,000	3
Very low	Only isolated errors associated with almost identical processes	1 in 150,000	2
Weak	Mistakes are unlikely. If there are any, they are not related to similar processes.	<1 at 1,500,000	1

* Error rate is expressed by the number of errors in a given number of products. *Mistakes* are all irregularities of a food product, from the action of a negative factor to the wrong cut of ready-made meat and errors in packaging.

Table 3. *Ranking the ease of detection*

Ease of detection	Explanation	Rang
Absolutely impossible	No available error detection controls are available	10
Very rarely	It is very unlikely that current controls will detect the manner in which the error occurred	9
Rarely	It is unlikely that current controls will detect the manner in which the error occurred	8
Very low	Very low probability that current controls will detect the way errors occur	7
Low	Low probability that current controls will detect the manner in which errors occur	6
Central	Central probability that current controls will detect the manner in which errors occurred	5
Medium high	Moderately high probability that current controls will detect the manner in which errors occur	4
Tall	High probability that current controls will detect the manner in which errors occur	3
Very high	There is a very high probability that the current controls will reveal the way errors occur	2
Quite certain	Reliable controls with similar processes are known, and current controls are certain that errors will be detected.	1

From the above, the general rule is that a higher RPN value in a certain link of the agri-food chain, or in a certain phase of the technological process of production, processing and logistics of food and food products, means higher risk. In doing so, the entire agri-food chain can, moreover, be segmented into smaller parts, ie:

- primary production,
- post-harvest management,
- transport,
- storage of agricultural raw materials in the warehouse of processors,
- processing into food products,
- storage and logistics of food products
- distribution and storage in sales centers.

It should be noted that the RPN may not play a crucial role in the choice of action against the mode of occurrence of errors in the technological process, but will help to identify areas of greatest concentration of errors, or critical control points in them. In other words, errors with a high number of RPNs should be given the highest priority in analysis and corrective actions.

Phase IV
Revision of critical control points in the decision tree based on calculated RPN values. Only after the implementation of phase III is it possible to determine the priority critical control points where the biggest errors occur in all processes, whether it is the inability to control chemical, physical and biological factors that pose a threat to human health, or only about mistakes that do not cause consequences for human health but cause faulty goods and products.

6.3.2 Risk management

Only after all four phases of risk assessment have been carried out is it possible to effectively manage risks. This specifically means:

- Application of *Good agricultural practices (GAP)* in primary agricultural production[21, 22, 23, 24],
- Application of *Good transportation practices (GTP)* for agricultural products[25], fish and shellfish[26, 27], livestock[28], and food products[29],
- Application of *Good manufacturing practices (GMP)*[30].
- Establishment of an adequate *traceability*[8] system
- Establishment of sampling and analytics systems
- Establishment of a documentation system
- Establish procedures to be applied when it is determined that a particular source of danger is not under control.

However, when it comes to risk management, it should be emphasized that the definition and implementation of risk management procedures, but also the implementation of risk assessment procedures, are greatly influenced by *different organizational subcultures* within different stakeholders in agri-food chains, and even within the same stakeholders, ie business and legal entities, within the same agri-food chain. Members of different subcultures may coincide in certain points of view, or may differ completely, and even conflict over some elements of risk assessment and management[31].

Therefore, the concrete engagement of all stakeholders in a particular agri-food chain is needed, but also of all employees within the same business entity in the role of stakeholders, in order to strengthen the culture of quality and strengthen safety in the agri-food chain. For this purpose, a relatively newer method for risk and benefit assessment, better known as *RBA* or full English name *Risk-Benefit Assessment*[32] proved to be useful.

The most effective way to control and manage risks in the agri-food chain is to implement the HACCP system (Hazard Analysis and Critical Control Points) and some quality management systems such as GlobalGAP for primary (agricultural) production and ISO 22 000 for quality management in the food industry.

In any case, it should be kept in mind that the effectiveness of risk management in agri-food chains depends not only on the successful determination and control of biological, chemical and physical factors that pose a food safety risk to consumer health, but also on a whole range of different threats and risks, such as market, health, criminal, political, technological and often neglected behavioral, institutional factors. When these threats are compounded by comparative benefits and costs (including usually neglected third party costs), effective risk management becomes questionable, especially in organizations, agri-food stakeholders who do not have sufficient financial power or human and technical resources to implement one quality management system[33].

The effectiveness of risk management depends primarily on the development of a culture of quality and safety culture of food products in each organization - a stakeholder of the entire agri-food chain. This is achieved through the commitment of management and development of a food safety culture of each employee[34].

[8] *cf.* ch. 1. Agri-food chains →1.6. Traceability in the agri-food chain

6.4 Global good agricultural practice

Global Good Agricultural Practice – Global G.A.P is a brand of smart farm insurance solutions developed by FoodPLUS GmbH in Cologne, Germany, in collaboration with manufacturers, retailers and other stakeholders from across the food industry. These solutions include a range of standards for safe, socially and environmentally responsible agricultural practices. The most commonly used GLOBALG.A.P. standard is Integrated Farm Assurance (IFA), applicable to fruits and vegetables, aquaculture, floriculture, livestock and more. This standard also forms the basis for the GGN label: Consumer label for certified, responsible agriculture and transparency.[9] Namely, the application of the HACCP system principle or hazard analysis and critical control points is not fully applicable in primary production[35]. However, the level of chemical, physical or biological hazard must be effectively assessed at all control points in primary production, whether it is the production of agricultural products intended for further processing into food products or the production of raw materials, ie livestock food. GLOBALG.A.P. started as EUREPGAP in 1997 as the world food retail chains required certification of tropical fruit producers according to the EUREPGAP methodology. To reflect its global reach and goal of becoming a leading international good agricultural practice (GAP), in 2007 EUREPGAP changed its name to GLOBALG.A.P.

Today, more than 200,000 manufacturers are certified by GLOBALG.A.P. standards in 134 countries around the world, which justifies changing the original name of EUREPGAP to GLOBALG.A.P.

The sales sector within the various agri-food chains has a major role to play in raising food quality safety standards to a higher level. In fact, the two voluntary consensus standards, namely the Global GAP and the British Retail Consortium[10] (BRC), are technical standards of wholesalers and retailers of food products and differ from HACCP or ISO standards developed through public bodies or among government agencies. As supermarket chains apply their own food safety standards, each agri-food industry or unit in the agri-food chain must take full responsibility for its own food safety unit. This idea has always been implemented to ensure the credibility as well as the effectiveness of the existing regulatory framework for food quality safety[36]. Therefore, GLOBALG.A.P. was created based on the initiative of food wholesalers (distributors) for those agricultural products that had and have a direct distribution channel to reach consumers. The main reason for launching GLOBALG.A.P. system is the prevention of food incidents, to protect consumer health and avoid paying large damages and penalties in case of acute or chronic consequences for consumer health in case of intoxication with food purchased in a particular food store, which is regulated by food law[37].

6.4.1 Traceability at the farm level through case studies of two food incidents

The first food incident occurred on December 27, 2010, when the first warning was issued by a German citizen from the state of Schleswig-Holstein, via the Rapid Alert System for Animal Feed and Food (RASFF[11]).[12] Namely, approximately 2,300 tons of dioxin-contaminated fat were distributed to 25 feed manufacturers in Germany in 2010. Fatty acids were intended for industrial use (ie for non-food purposes, namely biodiesel). However, the company Harles & Jentzsch in the province of Schleswig-Holstein[13], processed them into fats for animal feed. This alternative use was not allowed. Although the manufacturer was aware of the contamination of the material with dioxins, the countermeasures were not implemented, nor were the authorities informed. The dioxin load in compound feeds was finally detected by routine tests by feed manufacturers who used contaminated fats as feed ingredients. Feed manufacturers immediately notified the competent authorities. It is estimated that the total amount of feed mixtures contaminated with dioxin during 2010 is about 150,000 tons. Manufacturers of compound feeds that used dioxin-contaminated fat were quickly identified. In the first days of January 2011, feed manufacturers in 12 German provinces were affected, leading to the delivery of contaminated batches to approximately 4,760 farms. Some meat and egg samples have

9 https://www.globalgap.org/uk_en/who-we-are/about-us/

10 https://www.brc.org.uk/

11 https://webgate.ec.europa.eu/rasff-window/screen/search

12 https://ec.europa.eu/food/safety/rasff-food-and-feed-safety-alerts_en

13 https://www.cbc.ca/news/world/sales-from-4-700-german-farms-halted-over-dioxins-1.1028572

been found to have higher levels of dioxins than those allowed by EU law. No acute health consequences for consumers have been identified, as approximately 25.4 mg of dioxin has entered the food chain, according to a fact-based mathematical model published by the Federal Ministry of Food, Agriculture and Consumer Protection and the European Commission's Directorate-General for Health and Consumers. However, all products had to be disposed of in environmentally friendly manner. The economic impact, due to reduced consumption of food of animal origin and trade restrictions, was negligible[38].

The second food incident occurred on May 21, 2011, when Germany reported an ongoing epidemic of *Shiga* toxin produced by *Escherichia coli* (STEC), serotype O104: H4. From the initial case control study, the outbreak was related to the consumption of fresh vegetables for salad. Subsequent research has shown that the risk of infection is significantly associated with the consumption of freshly sprouted seeds and not with other fresh vegetables. A back-and-forth follow-up study showed that all cases for which sufficient information was available can be attributed to germinated seeds of fenugreek *(Trigonella foenum – graecum L.)* seed in Germany. Examination of the production site showed no evidence of environmental pollution. Employees were found to be infected, but since they did not become ill before the outbreak, it was concluded that they were not a source of food contamination.

Therefore, the most likely source is contaminated seed used to produce seedlings. Several patients with bloody diarrhea were subsequently reported after attending a local event in France on June 8. Consumption of germinated seeds is also associated with the onset of the disease. *Escherichia coli* (STEC) isolates, which are the cause of disease outbreaks in France and Germany, were found to be indistinguishable. It was therefore concluded that there is a common source for both outbreaks. A comparison of monitoring data on seeds from French and German sources of infection led to the conclusion that a certain consignment of fenugreek seeds *(Trigonella foenum – graecum L.)* imported from Egypt was most likely associated with an outbreak. On July 26, the Robert Koch Institute declared the epidemic over[39].

What was confirmed in both cases?

In both cases it was established that in the basic epidemiological procedure carried out during food incidents, we start from traceability, ie the entire agri-food chain is analyzed and the exact place where contamination with a certain source of danger was observed is determined regardless whether it is a biological, chemical or physical source of danger. Of course, in these two cases it was a biological, or more precisely a microbiological source of danger.

Therefore, when certifying primary food producers according to GlobalG.A.P. standards, great attention is paid to traceability.

6.4.2 Fundamentals of GlobalG.A.P. standard

GLOBALG.A.P. today it is the world's leading program for ensuring the quality of agricultural products, which turns consumer demands into good agricultural practice in an increasing number of countries around the world. The main purpose of GLOBALG.A.P. is to positively influence the world by providing solutions to global problems faced by agricultural supply chains, and this can only be achieved by harmonizing different standards of hygiene and health safety of food, environmental impact and welfare of workers and animals into an independent certification system, specifically GLOBALG.A.P.

There are two certification options per GLOBALG.A.P. standards:

The first option involves the certification of only one large agricultural producer who has organized production in only one location or in several locations of production areas and other production units owned by one producer (eg on several livestock farms, poultry, ponds, orchards, vineyards, on more protected space for growing vegetables and flowers, etc., located in different locations owned by the same manufacturer) with the implementation of *Quality Management System (QMS)* according to GLOBALG.A.P. standards.

The second option involves the certification of several smaller producers whose production areas and farms are located in different locations. In the case of certification under this option, the implementation of a quality management system according to GLOBALG.A.P. standards is mandatory. The second option is

most often chosen by small producers who, due to the placement of their agricultural products (who have a direct distribution channel to the consumer) in large retail chains, at the request of these customers must implement GLOBALG.A.P. standards, as evidenced by GLOBALG.A.P. certificate for a particular agricultural production.

The process of certification of primary producers according to GLOBALG.A.P. standards takes place in five steps:[14]

1. Any manufacturer may download on the GLOBALG.A.P. organization website documentation with relevant standards for individual agricultural production completely free of charge.
2. Each manufacturer may compare the offers of certification bodies registered in their own country or in a neighboring or nearest country. The manufacturer can then register with the certification body of their choice to obtain *GLOBALG.A.P. Number (GGN).*
3. Each manufacturer can, with the help of a selected consultant, conduct a self-assessment on the checklist items, which can be freely downloaded from GLOBALG.A.P. web pages. A consultant can be of great help in self-assessment to correct conditions that manufacturers do not meet.
4. Subsequently, each manufacturer shall agree on the date of the audit when the auditor of the certification body will conduct the audit.
5. When the manufacturer successfully meets the requirements of GLOBALG.A.P. standards for a particular production, the manufacturer receives GLOBALG.A.P. certificate, which will be valid for one year.

Every agricultural producer, regardless of whether their production is certified under the first or second option, extends thes certificate every year, if all the conditions of GLOBALG.A.P. standard are met after audit. GLOBALG.A.P. certificate, also known as the Integrated Farm Quality Assurance (IFA) standard, covers good agricultural practice standards for crop production, aquaculture, livestock and horticultural production. It also covers additional aspects of the food production and supply chain, such as the chain of control and the production of compound feeds.

6.5 Basics of HACCP system

The HACCP (Hazard Analysis and Critical Control Points) system is generally accepted as an efficient and cost-effective tool for ensuring the hygiene and health safety of food in food production and supply chains. The whole idea of HACCP was developed in 1959, when the American food company Pillsbury was given the job of producing food products that could be used in space capsules in gravity-free conditions. The hardest part of the program was to achieve almost 100% assurance that food products manufactured by Pillsbury for astronauts would not be contaminated with bacterial or viral pathogens, poisons, chemicals or any other physical source of danger that could cause illness or injury to astronauts which could lead to the interruption of the mission and even to the catastrophic outcome of the space mission. The basics of today's HACCP system were developed by Pillsbury in collaboration with the National Aeronautics and Space Agency (NASA), the US Army's Natick Laboratory, and the US Air Force Space Laboratory Project Group. In 1997, the World Health Organization recognized the importance of the HACCP principle for the prevention of foodborne diseases. HACCP principles are examples of mandatory standards in the food industry. At the same time, there are many private voluntary food safety management standards, and certification is believed to strengthen the functioning of HACCP in the food business. Examples of Internationally Recognized Private Voluntary Standards are: International Organization for Standardization (ISO) 9001, ISO 22000, British Retail Consortium (BRC), Global Food Safety Initiative Certification Standard, Good Agricultural Practice (Global GAP) or International Food Standard (IFS). However, they also include HACCP as the most important component[41]. Moreover, the HACCP system is applied not only in the food industry but also in the feed industry[42].

[14] https://www.globalgap.org/uk_en/what-we-do/globalg.a.p.-certification/five-steps-to-get-certified/

The HACCP system is based on *seven basic principles:*

6. The principle implies conducting a hazard analysis.
7. The principle implies the identification of critical control points (CCP) in the process in which controls can be carried out in order to prevent, or even eliminate, or reduce hazards to an acceptable level.
8. The principle implies the establishment of critical values for preventive measures to be implemented at each critical control point.
9. The principle implies setting requirements for monitoring critical control points and procedures for using monitoring results to adjust processes and maintain control.
10. The principle implies the establishment of corrective actions to be taken when the monitoring results show that a certain critical control point is not under control.
11. The principle implies the establishment of procedures for additional verification in order to confirm the effectiveness of the HACCP system.
12. The principle implies the establishment of documentation on all implemented procedures and records of all actions applied according to the above stated principles.

The introduction of the HACCP system is carried out through the following actions and procedures:

- *Forming a HACCP team.* In order for the implementation of the HACCP system to be effective, a trained HACCP team is necessary. HACCP team members must be professional and have production-specific work experience necessary to develop a HACCP plan. Responsibilities of the HACCP team include organizing and preparing the necessary documentation, preparing a HACCP study, reviewing deviations from control limits, organizing internal audits of HACCP plans, and communicating, educating and training employees on the operation of the HACCP system.
- *Product description.* The product description should include all information on ingredients, manufacturing process, retail, packaging and storage conditions and associated hazards. Furthermore, the product description requires information on the shelf life of the product, type of packaging, intended use with instructions for preparation and emphasis on the possible effects of this food product on specific populations (infants, immunocompromised individuals, elderly, etc.). In addition, the product description must include information on labeling, storage and distribution conditions.
- *Creating a flow chart.* The flow diagram is prepared by the HACCP team, which should identify all steps of the production process including steps before and after processing of raw materials in the plant.
- *Check the flow diagram on site.* It is implemented by the HACCP team and, if necessary, changes are made to the process flow diagram that correspond to the actual situation.
- *Program prerequisites.* They usually exist before the HACCP plan is developed. These include personal hygiene, good manufacturing practice (GMP), good hygiene practice (GHP), supplier quality assurance, maintenance, training. These should be implemented before assessing the implementation of HACCP.
- *Verification of good manufacturing practice.* This includes general rules on the production, handling and use of various food products.
- *Inspection of buildings, facilities and equipment.* Buildings, facilities and equipment should be located outside the area of environmental pollution, or areas prone to flooding. All buildings must have an adequate supply of drinking water, natural gas, electricity, a well-developed waste management system, ventilation, odor and vapor minimization system, air conditioning and dedusting system.
- *Verification of production and process control.* Raw materials or ingredients must not be accepted into the production process if they have been found to contain parasites, undesirable microorganisms, pesticide residues, antibiotic residues. Raw material quality control should be maintained continuously. Moreover, by reviewing the general condition of trucks used to transport low-moisture raw materials or frozen raw materials. Packaging materials should be hygienic, odorless and not react with either the food contained in it or the surrounding atmosphere. Finished products must be properly marked with product specifications to verify their compliance.
- *Establishment of control measures.* Control measures include program prerequisites and are essential for hazard screening at critical control points.

- *Determine critical control points (CCPs) and critical values in them.* An effective tool used in risk assessment, known as the *decision tree*,[15] is used to determine critical control points[18].
- *Development of HACCP plan.* The HACCP coordinator and the HACCP team for the development of the HACCP plan are responsible for the development of the HACCP plan. The HACCP plan must identify the sources of the various food safety hazards to be controlled in each CCP. Control measures, critical values, method of monitoring procedures, corrective actions if CLs do not have control, responsibilities and authorities, and process monitoring records must also be listed.
- *HACCP plan verification.* HACCP plan verification activities should confirm that the program prerequisites have been properly implemented and that the HACCP plan has been effectively implemented in all its elements.
- *Establishment of a traceability system,* as described in detail in ch. 1. Agri-food chains → 1.6. Traceability in the agri-food chain.
- *Defining corrective actions* to be taken in case of non-compliance, as described in detail in 1. Agro-food chains → 1.6. Traceability in the agri-food chain → point 5. Product recall.

However, once the HACCP system is established, the work of the HACCP team never ends. Namely, *the successful implementation and enforcement of the HACCP system implies its continuous testing and improvement,* and this is exactly what makes it sustainable. Continuous inspection and improvement procedures are also the most difficult part of the job[43].

6.6 BRC, IFS and ISO 22 000 food quality and safety management systems

As consumer interest in food safety has increased, so have food quality and safety management systems. Thus, in 1998, the *British Retail Consortium*[16] *(BRC),* in coordination with major UK retailers such as TESCO and Sainsbury, set standards for conducting quality audits of food suppliers. Each audit is conducted by certified organizations.

Prior to the introduction of the BRC standard, retailers conducted their own individual inspections. However, it soon became clear that joint inspections were cost-effective. Recently, the introduction of BRC standards has been demanded by retailers based in other European countries, and some of them have required their suppliers to revise their *Food Safety and Quality Standards* in line with BRC standards, and to provide relevant certification report data. *All HACCP system requirements are included in the BRC standards,* although more emphasis is placed on documentation, plant condition, product and process control procedures, and personnel.

Today, BRC standards are accepted by many food retail chains, service companies and food manufacturers around the world. Since 2015, translations of the Global Food Safety Standard have been available in many languages[44].

The basic elements of the BRC standard – BRCv7 are:

- assessment of the commitment of management and senior management to quality development (BRCv7 c.1.0),
- assessment of the food safety system – HACCP (BRCv7 c.2.0),
- inspection of the food safety and quality management system, ie inspection, documentation, registers, records, internal audit reports, supplier monitoring, specifications, traceability, corrective actions and incident management (BRCv7 c. 3.0),
- verification of construction standards related to; factory location, product flow and separation, construction work requirements, equipment maintenance, control of chemical and physical contamination of products, handling of raw materials and intermediates, preparation, processing, packaging and storage, types of control actions and procedures (BRCv7 c. 4.0),

[15] *cf.* Chap. 6.3.1. Risk assessment →Phase II

[16] https://brc.org.uk/about/

- product control (BRCv7 c. 5.0),
- process control (BRCv7 c. 6.0),
- hygienic control of staff (BRCv7 c. 7.0)[45, 46].

IFS or *International Featured Standards*[17] were introduced by German and French wholesale associations and joined by their Italian counterparts. The purpose of IFS is to develop a consistent evaluation system for all organizations that supply food products of brands[44].

The goal of IFS food standards certification is to assess the ability of manufacturers to produce food products that are safe, legal and in accordance with customer specifications. That is why the safety of food products and their quality are the most important component of all IFS standards, including Food Standards. The IFS assessment is product and process focused and ensures that the development of high quality products is achieved through appropriate functional processes[47]. In essence, IFS dietary standards do not differ much from BRC dietary standards.

ISO 22 000: 2018[18] food quality and safety management system ISO 22 000 was developed as a solution to improve food safety, instead of applying good manufacturing practice, which will international trade[48]. The basic elements of quality assessment according to ISO 22 000 standards are:

1. Structure and layout of buildings and related utilities
2. Layout of premises, including workspace and premises for employees
3. Stocks of air, water, energy and other utilities
4. Ancillary services, including waste and sewage disposal
5. Suitability and availability of equipment for easy cleaning, repair and preventive maintenance
6. Management of materials (eg raw materials, ingredients, chemicals and packaging), stocks (eg water, air, steam, and ice), disposal (eg waste and sewage), handling of processing and products (eg storage and transport);
7. Measures to prevent cross-contamination
8. Cleaning and disinfection
9. Pest control
10. Personal hygiene
11. Staff training
12. Other aspects, as appropriate.

The main advantages of the ISO 22 000 food quality management system are the following:

- provides some requirements that can be applied to any organization in the food chain in any country,
- is an internationally recognized standard,
- is subject to audit,
- allows a flexible approach, as organizations can choose which methods to use to meet ISO 22 000 requirements,
- can be independently applied to another food quality management system,
- can be easily integrated with another, already implemented quality management system, such as the HACCP system, which is a legal obligation,
- enables implementation in less developed organizations,

Through ISO 22 000, a combination of control measures has been developed, which enables efficient assessment and management of all risks[49].

[17] https://www.ifs-certification.com/index.php/en/standards/4128-ifs-food-standard-en

[18] https://www.iso.org/standard/65464.html

6.7 Social responsibility of stakeholders in the agri-food chain as a quality criterion

One of the unavoidable criteria in assessing the quality of stakeholders in the agri-food chain is the social responsibility of stakeholders in the agri-food chain. It is clearly explained in the United Nations document "Sustainable Development Goals"[19][50] and is derived from UN Resolution no. 70/1, adopted by the United Nations General Assembly on 21 October 2015[51].

The resolution defines a total of 17 sustainable development goals[20] and the International Organization for Standardization has adopted the ISO 26 000: 2010 "Guide to Social Responsibility".[21][52] ISO 26000: 2010 is not a management system standard. Moreover, it is not intended or suitable for certification purposes or regulatory or contractual use. ISO 26000: 2010 is a useful tool to help organizations contribute to the 17 goals of sustainable development, and it is intended to encourage organizations to go beyond compliance, recognizing that compliance is a fundamental duty of every organization and an essential part of their social responsibility[53].

Bibliography

[1] Evans, J. R., Lindsay, W. M. (1996) The Management and Control of Quality. 3rd edition, West Publishing Company. St. Paul. Minnesota, USA. 767 p.
[2] Garvin, D. A. (1988) Managing Quality: The Strategic and Competitive Edge. The Free Press. New York, USA. 319 p.
[3] Luning, P. A., Marcelis, W. J. (2006) A techno-managerial approach in food quality management research. Trends in Food Science & Technology, 17, 378–385. https://doi.org/10.1016/j.tifs.2006.01.012
[4] Luning, P. A., Marcelis, W. J. (2009) A food quality management research methodology integrating technological and managerial theories. Trends in Food Science & Technology, 20, 35–44. https://doi.org/10.1016/j.tifs.2008.09.013
[5] Moen, R., Norman, C. (2009) Evolution of the PDCA Cycle. "The History of the PDCA Cycle." In Proceedings of the 7th ANQ Congress, Tokyo 2009, September 17, 2009.
[6] Antunes Júnior, A., Broday, E. E. (2019) Adopting PDCA to Loss Reduction: A Case Study in a Food Industry in Southern Brazil. International Journal for Quality Research, 13, 335–348. https://doi.org/10.24874/IJQR13.02-06
[7] Samuelson, P. A., Nordhaus, W. D. (2004) Economics. McGraw-Hill, New York, USA. pp. 3–17.
[8] Friedman, M. (1970) Essays in Positive Economics. The University of Chicago Press, Illinois, USA. pp. 3–43.
[9] Luning, P., Marcelis, W., van der Spiegel, M. (2007) Quality assurance systems and food safety. Chapter in book: Safety in the agri-food chain. Luning, P. A., Devlieghere, F., Verhé, R. (eds.). Wageningen Academic Publishers. The Netherlands. pp. 249–299.
[10] Luning, P. A., Marcelis, W. J., Rovira, J., Van der Spiegel, M., Uyttendaele, M., Jacxsens, L. (2009) Systematic assessment of core assurance activities in a company specific food safety management system. Trends in Food Science & Technology, 20, 300–312. https://doi.org/10.1016/j.tifs.2009.03.003
[11] Deming, E. W. (1986) Out of Crisis. MIT, Center for Advanced Engineering Study, Cambridge, Massachusetts, USA. 507 p.
[12] Gartner, W. B. (1993) Dr. Deming Comes to Class. Journal of Management Education, 17, 143–158. https://doi.org/10.1177/105256299301700201
[13] Deming, E. W. (2018) The New Economics for Industry, Government, Education. Third Edition. MIT, Center for Advanced Engineering Study, Cambridge, Massachusetts, USA. 240 p.
[14] Mack, A., Schmitz, T., Schulze Althoff, G., Devlieghere, F., Petersen, B. (2007) Sreps in the risk management process. Chapter in book: Safety in the agri-food chain. Luning, P. A., Devlieghere, F., Verhé, R. (eds.). Wageningen Academic Publishers. The Netherlands. pp. 355–396.
[15] Boye, J. I., Danquah, A. O., Cin Lam Thang, Zhao, X. (2012) Food Allergens. Chapter in book: Food Biochemistry and Food Processing, Second Edition. Simpson, B. K. (ed.). John Wiley & Sons, Inc. pp. 798–819. https://doi.org/10.1002/9781118308035
[16] Harada, M., Akagi, H., Tsuda, T., Kizaki, T., Ohno, H. (1999) Methylmercury level in umbilical cords from patients with congenital Minamata disease. The Science of the Total Environment, 234, 59–62.
[17] Ráduly, Z., Szabó, L., Madar, A., Pócsi, I., Csernoch, L. (2020) Toxicological and Medical Aspects of Aspergillus-Derived Mycotoxins Entering the Feed and Food Chain. Frontiers in Microbiology, 10, 2908. https://doi.org/10.3389/fmicb.2019.02908
[18] Magee, J. F. (1964) Decision Trees for Decision Making. Harvard Business Review, 42, 126–138.
[19] Humber, J. (1992) Control Points and Critical Control Points. Chapter in book: HACCP: principles and applications. Pierson, M.D., Corlett, D.A., Jr. (eds.). Chapman & Hall. Lodnon, UK. 97–104. https://doi.org/10.1007/978-1-4684-8818-0
[20] Kiran, D. A. (2017) Total Quality Management: Key Concepts and Case Studies. Chapter 26: Failure Modes and Effects Analysis. Butterworth Heinemann, Elsevier. Oxford, UK. 373–389. https://doi.org/10.1016/C2016-0-00426-6
[21] Swanson, B. E. (2008) Global Review of Good Agricultural Extension and Advisory Service Practices. FAO, Rome. 64 p.
[22] http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.521.3652&rep=rep1&type=pdf

19 https://sdgs.un.org/goals

20 https://sdgs.un.org/goals

21 https://www.iso.org/standard/42546.html

[23] Rodrigues, R. de Quadros, Loiko, M. R., de Paula, C. M. D., Hessel, C. T., Jacxsens, L., Uyttendaele, M., Bender, R. J., Tondo, E. C. (2014) Microbiological contamination linked to implementation of good agricultural practices in the production of organic lettuce in Southern Brazil. Food Control, 42, 152–164. https://doi.org/10.1016/j.foodcont.2014.01.043
[24] Marine, S. C., Martin, D. A., Adalja, A., Mathew, S., Everts, K. L. (2016) Effect of market channel, farm scale, and years in production on mid-Atlantic vegetable producers' knowledge and implementation of Good Agricultural Practices. Food Control, 59, 128–138. https://doi.org/10.1016/j.foodcont.2015.05.024
[25] Parikhani, M. P., Borkhani, F. R., Fami, H. S., Motiee, N., Hosseinpoor, A. (2015) Major Barriers to Application of Good Agricultural Practices (GAPs) Technologies in Sustainability of Livestock Units. International Journal of Agricultural Management and Development, 53, 169–178. https://doi.org/10.5455/ijamd.161640
[26] Rajabion, L., Khorraminia, M., Andjomshoaa, A., Ghafouri-Azard, M., Molavi, H. (2019) A new model for assessing the impact of the urban intelligent transportation system, farmers' knowledge and business processes on the success of green supply chain management system for urban distribution of agricultural products. Journal of Retailing and Consumer Services, 50, 154–162. https://doi.org/10.1016/j.jretconser.2019.05.007
[27] Parvathy, U., Ankur Nagori, Binsi, P. K., Ravishankar, C. N. (2020) Transportation Prototype for Live Distribution of Mud Crab in Seafood Supply Chain. Fishery Technology, 57, 69–71. https://krishi.icar.gov.in/jspui/bitstream/123456789/36746/1/Transportation%20Prototype%20for%20Live%20Distribution.pdf
[28] Martins, W. S., Leite, A. B. de C., Martins, R. L., da Silva, J. O., Balian, S. de C. (2019) Assessment of Frozen Seafood Good Storage Practices in the 21st Supply Deposit of the Brazilian Army. Brazilian Journal of Veterinary Research and Animal Science, 56, e151385. https://doi.org/10.11606/issn.1678-4456.bjvras.2019.151385
[29] Buddle, E. A., Bray, H. J., Ankeny, R. A. (2018) "I Feel Sorry for Them": Australian Meat Consumers' Perceptions about Sheep and Beef Cattle Transportation. Animals, 8, 171; https://doi.org/10.3390/ani8100171
[30] Chapman, B. J., Linton, R. H., McSwane, D. Z. (2021) Food safety postprocessing: Transportation, supermarkets, and restaurants. Chapter in book: Foodborne Infections and Intoxications. J. Glenn Morris, Jr., Vugia, D. J. (eds.). Academic Press, Elsevier. 523–544. https://doi.org/10.3390/ani81001710.1016/B978-0-12-819
[31] De Oliveira, C. A. F., da Cruz, A. G., Tavolaro, P., Corassin, C. H. (2016) Food Safety: Good Manufacturing Practices (GMP), Sanitation Standard Operating Procedures (SSOP), Hazard Analysis and Critical Control Point (HACCP). Chapter in book: Antimicrobial Food Packaging. Barros-Velázquez, J. (ed.). Academic Press, Elsevier. 129–139. https://doi.org/10.1016/B978-0-12-800723-5.00010-3
[32] Manning, L. (2017) The Influence of Organizational Subcultures on Food Safety Management. Journal of Marketing Channels, 24, 180–189. https://doi.org/10.1080/1046669X.2017.1393235
[33] Assunçãao, R., Pires, S. M., Nauta, M. (2019) Risk-Benefit Assessment of Foods. EFSA Journal, 17(S2): e170917, 8 p. https://doi.org/10.2903/j.efsa.2019.e170917
[34] Bachev, H. (2012) Risk Management in the Agri-food Sector. Contemporary Economics, 7, 45–62. https://doi.org/10.5709/ce.1897-9254.73
[35] Nyarugwe, S. P., Linnemann, A. R., Luning, P. A. (2020) Prevailing food safety culture in companies operating in a transition economy - Does product riskiness matter? Food Control, 107, 106803. https://doi.org/10.1016/j.foodcont.2019.106803
[36] Cerf. O., Donnat, E. (2011) Application of hazard analysis – Critical control point (HACCP) principles to primary production: What is feasible and desirable? Food Control, 22, 1839–1843. https://doi.org/10.1016/j.foodcont.2011.04.023
[37] Okpala, C. O. R., Korzeniowska, M. (2021) Understanding the Relevance of Quality Management in Agro-food Product Industry: From Ethical Considerations to Assuring Food Hygiene Quality Safety Standards and Its Associated Processes. Food Reviews International, https://doi.org/10.1080/87559129.2021.1938600
[38] EC (2002) Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety. http://data.europa.eu/eli/reg/2002/178/oj
[39] Zentek, J., Knorr, F., Mader, A., Schafft, H. (2012) Lessons from the large-scale incident of animal feed contamination with dioxins in Germany in 2011. Chapter in book: Case Studies in Food Safety and Authenticity. Hoorfar, J. (ed.). Woodhead Publishing. 296–300. https://doi.org/10.1533/9780857096937.6.296
[40] European Food Safety Authority (2011) Shiga toxin-producing E. coli (STEC) O104:H4 2011 outbreaks in Europe: Taking Stock. EFSA Journal, 9(10), 2390. https://doi.org/10.2903/j.efsa.2011.2390
[41] Bauman, H. E. (1992) Introduction to HACCP. Chapter in book: HACCP: principles and applications. Pierson, M. D., Corlett, D. A., Jr. (eds.). Chapman & Hall. Lodnon, UK. 1–5. https://doi.org/10.1007/978-1-4684-8818-0
[42] Trafialek, J. (2016) Implementation and functioning of HACCP principles in certified and non-certified food businesses. A preliminary study. British Food Journal, 119, 710–728. https://doi.org/10.1108/BFJ-07-2016-0313
[43] Den Hartog, J. (2003) Feed for Food: HACCP in the animal feed industry. Food Control, 14, 95–99. https://doi.org/10.1016/S0956-7135(02)00111-1
[44] Varzakas, T. (2016) HACCP and ISO22000: Risk Assessment in Conjunction with Other Food Safety Tools Such as FMEA, Ishikawa Diagrams and Pareto. Encyclopedia of Food and Health, Reference Module in Food Science. 295–302. https://doi.org/10.1016/B978-0-12-384947-2.00320-2
[45] Kotsanopoulos, K. V., Arvanitoyannis, I. S. (2017) The Role of Auditing, Food Safety, and Food Quality Standards in the Food Industry: A Review. Comprehensive Reviews in Food Science and Food Safety, 16, 760–775. https://doi.org/10.1111/1541-4337.12293
[46] Miarka, D., Urbańska, B., Kowalska, J. (2019) Traceability as a tool aiding food safety assurance on the example of a food-packing plant. Accreditation and Quality Assurance, 24, 237–244. https://doi.org/10.1007/s00769-018-01370-8
[47] British Retail Consortium, BRC (2015) Global Standard Safety ISSUE 7. London. https://www.brcgs.com/media/63848/brc_global_standard_for_food_safety_issue_7_faqs-1.pdf
[48] Internationa Featured Standards (2020) Standard for assessing product and process compliance in relation to food safety and quality, version 7.
[49] https://www.ifs-certification.com/index.php/en/standards/4128-ifs-food-standard-en
[50] Panghal, A., Chhikara, N., Sindhu, N., Jaglan, S. (2018) Role of Food Safety Management Systems in safe food production: A review. Journal of Food Safety, 38, e12464. https://doi.org/10.1111/jfs.12464

[51] Petró-Turza, M. (2014) Institutions involved in foodsafety. Encyclopedia of Human Nutrition, 4, 379–383. https://doi.org/10.1016/B978-0-12-378612-8.00392-9
[52] ISO (2018) Contributing to the UN Sustainable Development Goals With ISO Standards. ISBN 978-92-67-10790-5. https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100429.pdf
[53] UN (2015) 70/1. Transforming our world: the 2030 Agenda for Sustainable Development. https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E