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# Traceability as a management tool for processing poultry products

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# Traceability as a management tool for processing poultry products

**S Valdokhina[1], I Vedenkina[1] and L Roiter[1]***

[1] All-Russian Research and Technological Poultry Institute of Russian Academy of Sciences, 10 Ptitsegradskaya str., Sergiyev Posad 141311 Russia

E-mail: department.economy.vnitip@yandex.ru

**Abstract**. The purpose of this article is to consider the traceability system from the standpoint of a tool for managing technologies for processing poultry products. The issues of quality and safety of poultry products are considered in the paper, along with the technology of slaughter, primary and deep processing of poultry meat and eggs. Authors also discuss the sequence of implementation of each stage of the technological process, identifying critical control points and causes of deviations from the regulatory parameters in the implementation of technological solutions. Violations of critical limits along the whole chain of the technological process of processing poultry products are among the main factors that reduce the performance of technologies for the implementation of relevant processes. As an effective tool in solving these problem areas, namely, improving the effectiveness of technological solutions, is a traceability system that allows one to develop corrective and preventive actions to eliminate the resulting deviations during slaughter, primary and deep processing of eggs and poultry meat.

## 1. Introduction

Public concern about food safety is now extremely high. Safety is the most important criterion that determines the quality of food products.

In accordance with the TR CU 021/2011 “On the Safety of Food Products” adopted on February 15, 2015, in the implementation of food production (manufacturing) processes related to the safety requirements of such products, manufacturers must develop, implement, and maintain procedures based on the principles of the Hazard Analysis and Critical Control Points/Food Safety Management Systems (HACCP) [3]. The main objective of this system is to provide control at all stages of the production process, as well as during storage and sale of products, namely where a dangerous situation may arise that is related to consumer safety. Most economic entities have already implemented the HACCP system, which has made it possible to reduce and eliminate the impact of hazardous factors and minimize them.

Traceability goes hand in hand with the quality management system (QMS), since one of the most important control operations and merchandising characteristics of products is their identification, which in turn is an element of the QMS during production and the means of product traceability. The quality management system is an organized management system that is necessary for the management of an enterprise in order to ensure the required level of product quality. QMS is founded in accordance with the concept of Total Quality Management, namely, a continuous improvement of the quality of all business processes of an enterprise, a systematic approach to management, focused on customer satisfaction [4].

Food traceability is the ability to document the manufacturer and subsequent owners of the food products in circulation, except for the end user, as well as the place of origin (production, manufacturing) of food products and/or food raw materials [1].

When introducing traceability, the GS1 system is best suited for its organization. GS1 Unique Global Identifiers are keys to provide access to all data on the product history and location. Each product is assigned a global GTIN trade item number, combined with a batch number and assigned to each of three levels when packing: a consumer unit, a trade unit, and a pallet (considering that it is a trade unit) [5].

When developing a traceability system in an enterprise, it is necessary to identify objectives that are achieved with regard to the principles of the security system. The overall objectives of the traceability system are regulated by the GOST R ISO 22005-2009 "Traceability in the Chain of Production of Feed and Food. General Principles and Basic Requirements for Designing and Implementing the System" [2].

With the saturation of the poultry meat market, which has been noted in Russia over the past years, the competitive struggle of poultry enterprises is to maximize the potential of their products through the sale of these products by the largest retailers and non-systemic trade through distributors, wholesalers, processors. However, the issue of traceability and security guarantees for finished products becomes decisive. Therefore, Russian retail chains (Magnit, Lenta, "OK") apply equally stringent criteria when selecting suppliers. Each network today has not only its own veterinary and sanitary specialists, but it also introduces a quality manager at most outlets [6].

With increasing competition and consolidation of B2B producers and customers (retail, food service and processing) to traceability and certification systems, requirements are becoming more unified. Traceability in the GlobalGap system is used in 112 countries by 1,400 inspectors and 142 organizations that control the level of supply of hatching eggs, breeding stock, and commercial stock, feed production. More than half of the 304 critical control points in the GlobalGap certification system ensure both the product safety and traceability of poultry fattening processes.

The most striking practical example in the area of the traceability system function is the M-TechSystem management system, which is used by 120 of the world's largest poultry and pig enterprises, including in Russia. Such systems allow poultry enterprises to carefully control the quality and safety of their products, which are supplied to both domestic and foreign markets [6].

The introduction of a traceability system by an enterprise depends on its technical capabilities. It is traceability that makes it possible to identify deviations in the processing technologies of poultry products [10].

However, traditionally traceability was considered from the standpoint of controlling business processes at the entrance and exit of poultry processing products, and not as a tool for managing processing technologies, that is, not from the standpoint of evaluating the effectiveness of technological solutions. In this regard, the issue of traceability as a tool for managing technologies for the processing of poultry products is very relevant.

The implementation of this approach will allow considering the traceability system from the standpoint of variants of the production technology and processing of poultry products at any stage of the technological process leading to the occurrence of a defect, return to this stage, install equipment, process conditions, etc.

## 2. Methods

The study used such methods as structural, systemic and comparative analysis, the method of graphic illustration and groupings, which allowed to identify the relationship of technical and technological potential in the system of traceability.

## 3. Results

The globalization of trade, the complication of production processes, and distribution processes in supply chains require a fundamental review of the functioning of poultry products life cycle schemes in order to ensure the delivery of safe and high-quality products to the consumer. This goal is achieved by introducing a traceability system in the food industry. For the organization of the traceability system should be organized strict input control of material resources, accounting factors, such as technological regimes, the use of raw materials, weight parameters.

According to Rosptitsesoyuz, 4 million 940 thousand tons of poultry meat in the slaughter mass was produced by all categories of farms in 2017, which was 319 thousand tons (or 7%) more than in 2016. Per capita consumption of meat was 34.1 kg. In the total production, the share of poultry meat of all types of livestock and poultry reached 48%. There were 44.8 billion eggs produced in 2017. Compared to 2016, the increase in the production of eggs was 1.2 billion, or 2.8%, respectively. The consumption of eggs per capita has reached an average level of 285 eggs.

In Russia, poultry meat exports amounted to 163 thousand tons in 2017, which was more than the level of 2016 by 48 thousand tons (or 42%). Note that the share of poultry meat exports in the total export of meat products in 2017 was 65%. At the same time, 34% of deliveries were carried out to foreign countries (Abkhazia, Egypt, Vietnam, the United Arab Emirates, Thailand, etc.), 66% of export meat was received in the nine CIS countries (Ukraine, Kyrgyzstan, Kazakhstan, Armenia, etc.) In 2018, it iwas planned to supply 210 thousand tons of poultry meat for export, reaching 350–500 thousand tons by 2020.

The export of edible eggs amounted to 435 million units, which was 215 million eggs more than in 2016 (almost twice). The buyers of egg products were the seven foreign countries: Abkhazia, Mongolia, the United Arab Emirates, Japan, Qatar, and others, which amounted to 45% of the export share. In the CIS countries (Ukraine, Kazakhstan, Armenia, Belarus, Tajikistan, Kyrgyzstan), 55% of the total weight was delivered.

These results were largely achieved thanks to the systematic development of the poultry industry, the attraction of investments and the large-scale introduction of scientific and technical developments, as well as the increase in the product competitiveness, which made it possible to improve the export potential of the industry. The range of products for poultry meat and eggs is expanding due to deep processing. All this requires the use of modern equipment and technology. At the same time, in the industry during the slaughter of poultry and processing of products from it, the mainly imported equipment is used (Figure. 1).

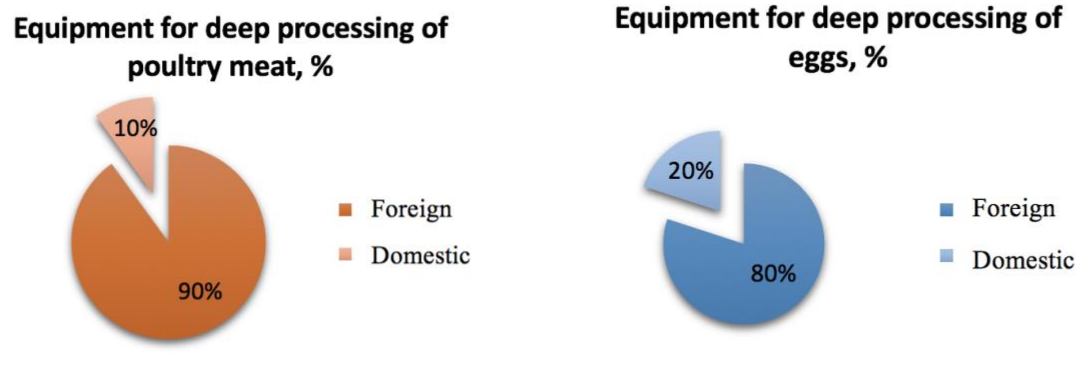


**Figure 1.** Equipment for deep processing of poultry meat and eggs.
Source: Rosptitsesoyuz.

For each assortment position are developed process flow diagrams. The technological process of poultry processing for the lines of any manufacturers is the same and includes the following main steps:

- Acceptance and primary processing of poultry;
- Gutting bird carcasses during its preliminary cooling;
- Sorting and packaging of whole carcass offal;

– Refrigerated processing products;
– Collection and recycling of technical waste.

This article, on the example of a slaughter and primary processing scheme, provides a process diagram for the production of poultry meat for mechanical deboning, as well as a technological process for producing egg mass.

In the poultry industry, domestic technologies are used in the processing of products.

The above technologies for processing poultry products are integrated in the relevant tables, which provide information about technological stages, controlled parameters, possible permissible critical aisles, In addition, our tableindicate corrective actions in case of non-compliance with parameters (Table 1) [7].

We will consistently consider these technological processes with a description of the problem areas in each of them.

The main stages of the technological process for the slaughter and processing of poultry:

– Hanging;
– Stunning;
– Slaughter, slaughter control;
– Gutting;
– Washing carcasses;
– Cooling.

**Table 1.** Critical control points in the slaughter and primary processing of poultry.

| No CCP | Process Points | Controlled parameters (control actions) | Critical limits | Impact results (consequences of non-compliance with parameters) | Corrective actions |
|---|---|---|---|---|---|
| 1 | Quality control of carcasses gutting | Quality | (In accordance with ND) GOST 21784, GOST 31962, GOST R 52306, GOST 31473, GOST R 53458 GOST R 52820, GOST R 54673 | In case of non-observance of the technological parameters of gutting (remnants of internal organs), an increase in microbiological seeding is possible. | To finalize bird carcasses. |
| 2 | Cooling | Temperature in the thicker muscles | 2±2°C<br>(0-4°C) | In the case of increasing the temperature of the product, there is an intensive multiplication of microorganisms. | Direct to the refrigerator and cool to the specified values. |

The analysis shows that not all risks may bring harm to the consumer's health, but at the same time dangerous factors arise at different stages of the process. The development of microflora, the deterioration of the microbiological indicators of poultry meat may be due to violations of the technological regime in the next stages of the process: gutting, carcass washing: the growth of microflora causes insufficient and low-quality washing, cooling. This indicates the possibility of a cumulative effect in violation of various technological parameters [3]. To reduce the risk of harm to health, preventive actions are developed at certain stages of the process [7, p. 280].

In the production of most products of deep processing, the first stage is to obtain boneless meat, i.e. boning of poultry carcasses and its parts [8].

The production of mechanically deboned meat includes semi-finished products, sausages, canned goods, pies and occupy the largest share in the production of deep processing products.

The technological process of production of poultry meat boning includes:

– Carcasses of small birds and parts of carcasses;
– Cooling;
– Separation;
– Grinding;
– Freezing;
– Packaging.

When analyzing the process of production of poultry meat by mechanical deboning, control points were identified. It was established that in the process of their production dangerous factors were such as the development of microflora due to violation of storage, cooling, freezing, violation of critical temperature limits of meat, package integrity. The analysis of the controlled parameters of the mechanical process of meat boning with regard to critical limits and preventive actions allowed determining critical control points (Table 2) [7, p. 281].

**Table 2.** Critical control points of the mechanical process of poultry meat boning.

| № CCP | Process points | Controlled parameters (control actions) | Critical limits | Impact results (consequences of non-compliance with parameters) | Corrective actions |
|---|---|---|---|---|---|
| 1 | Cooling | Temperature, ° C | 2±2°C (0-4°C) | In case of increasing the temperature of the product, there is an intensive multiplication of microorganisms. | Direct to the refrigerator and cool to the specified values. |
| 2 | Separation | Producttemperature, ° C | Notmorethan 8 ° C | In case of non-compliance with the temperature regime, there is a rapid growth of microflora. | Direct to the refrigerator and cool to the specified values. Send to freezing. |
| 3 | Cooling | Producttemperature, ° C | 2±2°C | In case of increasing the product temperature, there is an intensive multiplication of microorganisms | Direct to the refrigerator and cool to the specified values |
| 4 | Freezing | Producttemperature, ° C | -12°C | In case of increasing the product temperature, there is an intensive multiplication of microorganisms. | Freeze again. |
| 5 | Storageofchilled product | Air temperature in the chamber, ° C | -2… -4 ° C no more than 16 hours | In case of violation of the storage mode, the reproduction of microorganisms is possible, leading to deterioration | Direct to the refrigerator and cool to the specified values. Products are recycled. By decision of the veterinary sanitary doctor, expired products |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | should be sent for industrial processing |

As can be seen from the presented data, in the process of poultry meat production with mechanical deboning, the development of microflora was revealed due to violations of the storage, cooling, freezing regimes, as well as critical limits of meat and package integrity.

The range of egg products is much narrower than poultry meat. This direction is only gaining the momentum; therefore, the quality of egg products is an extremely important task for both domestic and foreign markets [15]. Despite the fact that an egg is a specific product that has its own protection in the form of a shell, there are also factors during its processing that reduce the safety of the production of egg products [13;14]. Consequently, in enterprises with deep processing of eggs, the traceability system should be an integral part that can increase their profitability.

Production of various types of egg products can be organized at one or two egg-processing enterprises. The main products of industrial processing of eggs are liquid (melange, protein, yolk), concentrated and similar dried egg products, as well as mixtures with various components, some of which are imported, have the potential to increase their exports (Figure 2).

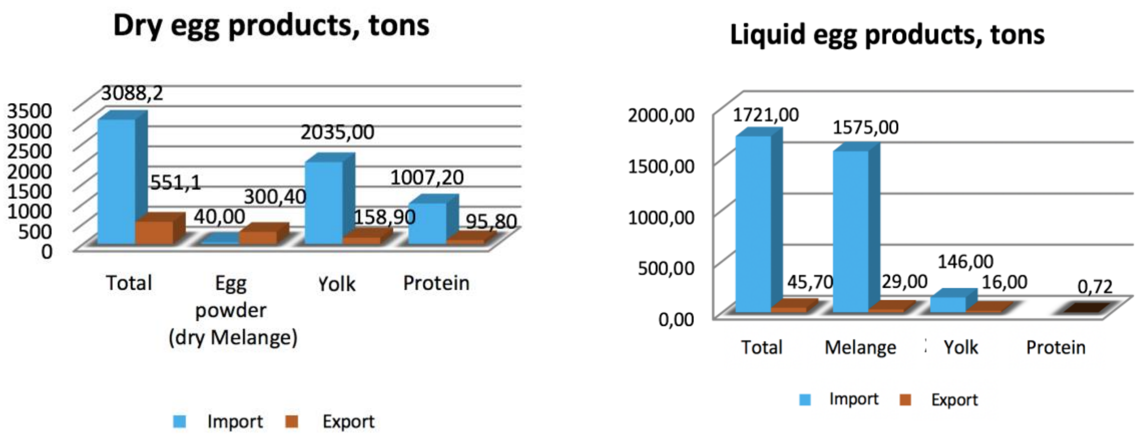


**Figure 2.** The market of dry and liquid natural egg products in Russia in 2017.
Source: Rosptitsesoyuz.

The process of obtaining egg mass includes a number of technological steps:

- Acceptance of eggs in the shell;
- Egg storage;
- Washing;
- Freezing;
- Defrosting;
- Recycling.

For all productions of egg products there are common processes, mainly obtaining egg masses (melange, protein, yolk). In the production of egg products, the following hazardous factors may be: microbiological, physical, as well as the development of microflora due to violation of the critical temperature limits during the freezing and thawing of the product. The analysis of the technological process of primary processing of egg products is presented in Table 3. [7, p. 309].

**Table 3.** Critical control points (CCP) of the technological process of egg products.

| № CCP | Technological stages | Danger | Monitoring | Warning effects | Corrective actions |
|---|---|---|---|---|---|

| | **process** | | | | |
|---|---|---|---|---|---|
| 1 | Filtration. | Physical: ingestion of foreign materials. | Inspection of filters after each cleaning or before each working cycle. | Use closed containers and pipes; regularly remove waste from filters, clean and disinfect them; do not delay an egg product before cooling. | Filter replacement; stop processing a product in case of deviation of the process mode from the nominal value; re-filtering. |
| 2 | Heat treatment (pasteurization of liquid products). | Biological: the survival of pathogenic microbes and their reproduction. | Continuous change in product temperature; continuous monitoring of equipment operation. | Regularly check the integrity of the working surfaces of equipment (plates, pipes, gaskets); use materials in contact with the product only from the list of approved in the food industry; timely calibration of measuring instruments. | Re-processing; adjustment of temperature of the heat carrier; additional cooling or heating; disposal of nonconforming products. |
| 3 | Drying. | Biological: pollution, survival of pathogenic microbes and their reproduction. | Moisture control of each batch of product (or solids content) at the outlet of the dryer | Clean and disinfect the equipment surfaces; regularly check their condition; filter the dryer; clean the filters regularly; prevent dry product from contact with moist air. | Regulation of air temperature or product flow; disposal of non-compliant products; repair of drying equipment in case of a defect. |
| 4 | Dry product packaging. | Physical: ingestion of foreign materials. | Continuous sifting through the sieve of the product at the outlet of the dryer; continuous passage through a metallodector or magnet of each packaged batch. | Install a strainer on the product outlet; install a metal detector or magnet; limit the number of small items in the outlet area of the dryer and product packaging; when moving or storing the equipment must be cleaned and disinfected; split rooms for pasteurized and unpasteurized dry product; restriction of movement of personnel and vehicles used to transfer the product. | Cleaning and maintenance of the drying tower; cleaning, maintenance of air filters; repair or replacement of screens; isolation of nonconforming product batches; determination of the origin of foreign inclusions; ensuring the possibility of re-processing or disposal of contaminated batches. |
| 5 | Heat treatment of dry protein (before or after packaging). | Microbiological: the survival of pathogenic microbes and their reproduction. | Continuous recording of product temperature and air (humidity) during batch processing in a hot room. | Label pasteurized and non-pasteurized dry products; regularly calibrate measuring instruments; air ventilation in a hot room to ensure | Temperature correction in a hot room; additional processing. |

| | |
|---|---|
| | uniform temperature. |

Consumer packaging is marked with information that is required for traceability, and it reflects specific information for consumers in accordance with the rules. It is worth noting that the use of a traceability system in advanced enterprises has been implemented and successfully operates in accordance with regulated technological processes.

## 4. Conclusions

In the process of studying the problem, it was found that most scientists considered the traceability system from the position of its main constituent elements, and not as a tool for managing the technologies of poultry production [11, 12]. In our opinion, just such an approach to the traceability system in poultry enterprises will contribute to the "transparency" of technological operations, their compliance with the established requirements, and product competitiveness. The research focused on individual technological processes of processing eggs and poultry meat in order to identify deviations from the limit values of each of the stages of the technological process and determine the causes of their occurrence.

At the same time, the problem area of the current traceability system is the adjustment of control actions aimed at ensuring the optimal production technology of poultry products under conditions of uncertainty of parameters and is achieved by matching the control actions and the final products of the required quality. Our analysis revealed violations in the processing technologies of poultry products and allowed us to build a system of corrective actions.

It should be noted that it is necessary to improve the regulatory and information base on which experts rely when implementing a traceability system. To improve the efficiency of the traceability system in poultry enterprises and to improve technological processes in the production of relevant products, it is necessary to comply with the basic requirements set by retail customers, as well as catering chains and processors of poultry products.

Thus, the problem raised in the article is aimed at improving the efficiency of technical and technological parameters in the processing of poultry products through the adaptation mechanism of the traceability system in poultry farms.

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