Metrological support in the quality management system of a poultry enterprise

S I Valdokhina, L M Roiter and I V Vedenkina
Federal State Budgetary Scientific Institution Federal Scientific Center "All-Russian Scientific Research and Technological Institute of Poultry Farming" of the Russian Academy of Sciences. Ptitsegradskaya st. 10, Sergiev Posad, Moscow region, 141311, Russia
E-mail: svetlana.valdohina@mail.ru

Abstract. The article deals with the issues of metrological support of business processes of a poultry enterprise within the framework of the quality management system (QMS). On the basis of the systematization of international and national QMS standards and relevant methods, an industry-wide integrated model of QMS business processes has been developed, their characteristics are given, indicating their interaction. The role of the business process "Metrological support" in the efficiency of the functioning of the life processes of the QMS has been substantiated. A map and an algorithm for this process has been developed, which forms its regulations with an illustration of the main parameters of the presented schemes. The role of devices characterizing the quality of incubation and food eggs with the use of appropriate technical means and devices, indicating the results of research, the morphology of eggs in comparison with standard parameters, from which it can be seen that the existing individual violations of their values are not associated with metrological support, is highlighted.

1. Introduction
The presence of a quality management system at the enterprise is very important, from the point of view of an assistant in achieving the desired results of increasing the efficiency of its activities - every business entity that is dynamically developing in the market seeks to increase its competitiveness and satisfy the consumer with quality products.

The QMS allows you to transfer to a higher level all business processes of production management activities of any enterprise, including poultry, to reduce the time spent on testing, taking into account the improvement of the quality of work performed: monitoring and managing the state of equipment when performing measurements and determining the algorithm for implementing their methodology execution. [1]

There are several approaches to QMS - functional and process.

The process approach is most effective today, because any activity that uses resources to transform inputs into outputs can be considered a process that is consistent with the definition given in the ISO 9001 family of standards. the identification and management of the processes applied within the enterprise and interacting with each other is called the “process approach”.

Within the framework of the process approach, it is necessary to take into account the specific activities of an economic entity. This is especially true for agriculture, including animal husbandry.
For a long period, among the subsectors of animal husbandry, the leading position has been taken by poultry farming, which is based on innovative technologies for keeping, growing and feeding poultry. At the same time, business processes that ensure the effective functioning of a poultry enterprise and its competitiveness largely depend on the metrological support of each of them. [2,3]

In this regard, this study is aimed at studying the system of business processes in the whole poultry enterprise, their differentiation, within the framework of the QMS, highlighting the relevance of the business process “Metrological support”.

2. Research results

Any business entity operates within the framework of certain business processes that have their own industry specifics.

Based on the study of the QMS, in accordance with the developed international and national standards ISO 9001 series, the business processes of the poultry enterprise were systematized and analyzed, on the basis of which an integrated model of the process approach in poultry farming was developed (figure 1) [4].

![Image](image_url)

**Figure 1.** Scheme of the integrated process model of the QMS of a poultry enterprise.

According to this model, there are three main blocks:

- Management processes;
- Life cycle processes;
- Supporting processes.

Within each of them, sub-processes are highlighted. To a large extent, the block of life cycle processes is influenced by supporting processes, and first of all, under the sub-process - "Control of..."
instrumentation”, that is, “Metrological support” of all means of production involved in the processes of the life cycle.

For each process, a map and an algorithm have been developed, including a similar diagram and drawing are given for the sub-process "Metrological support", which have specific regulations for its functioning. It should be noted that at present, the poultry industry is characterized by innovative development in the field of technologies for keeping, growing and feeding poultry. Metrological support in poultry farming, as well as in other sectors of the national economy, consists in ensuring the required quality of measurements: unity, accuracy and reliability, which is especially important in the QMS.

Russian poultry enterprises are actively adapting the QMS based on the package of international quality standards ISO 9001 series. These standards show metrology as the most important link uniting the methodological and technical components of measurement, testing and control. The sphere of state metrological control and supervision includes the law on ensuring the uniformity of measurements - Federal Law of the Russian Federation dated June 26, 2008 No. 102 - FZ “On ensuring the uniformity of measurements” [5].

Let us illustrate in more detail the research on the "Metrological support" process. Taking into account the importance of this business process, a map and an algorithm of this business process, presented in figures 2 and 3, have been developed.

Based on the resources presented, it can be stated that the business process "Metrological support" is based on four control actions, taking into account the requirements of the relevant GOSTs, namely:

- Regulatory and technical documentation;
- Position, job description;
- Legislative and regulatory acts;
- Organizational and administrative documentation.

These impacts are considered for both suppliers and consumers.

It must be said that the purpose of the process is to ensure the uninterrupted operation of measuring instruments, timely verification of measurement systems (MS). The implementation of this goal can be carried out with appropriate resources.

The main resources for achieving the goal include: qualified personnel, vehicles, communications, financial resources.

The algorithm of this sub-process shows the sequence of all procedures necessary for the implementation of metrological assurance.

Of particular relevance is the metrological support of instruments related to the reproduction of poultry and the quality of both incubation and edible eggs. The problem of improving the quality of edible and hatching eggs is solved through innovative methods of their objective assessment.

Improving the quality of eggs is closely related to metrological support and control, which is necessary for the prompt adjustment of the work of the relevant services and production workshops [6, 7].

Important conditions for metrological support are: reliable technical means of control and the availability of regulatory documents reflecting the basic requirements for the quality of eggs.

Such technical means include: a device for assessing the quality of the egg shell by its elastic deformation. The device allows, with full preservation of the integrity of the shell, with high productivity of the operators, to determine the incubation and commercial qualities of eggs. An index meter is used to measure the shape of an egg by the ratio of the transverse to longitudinal diameter (shape index). Studies show that the results of using this device are associated with hatchability and damage to eggs. Chicken eggs with a shape index below 70% and above 80% give a 5% reduction in hatch. Also, there is a device for determining the freshness and assessing the quality of the egg white without opening them.
Figure 2. Map of the sub-process "Metrological support" (regulations).
Figure 3. Algorithm of the sub-process "Metrological support".
The combination of the effectiveness of these devices in the morphological analysis of eggs ensures the effective functioning of a number of processes to obtain quality products. The results of using a number of devices are shown in Table 1.

Table 1. Results of the analysis of the quality of eggs.

| Indicator                                | Standard | Groups |
|------------------------------------------|----------|--------|
|                                          |          | 1     | 2     | 3     |
| Egg mass, g                              | 48 – 80  | 46.1  | 58.1  | 57.2  |
| Density, g/cm³                           | <1.075   | 1.095 | 1.080 | 1.085 |
| Egg shape index, %                       | 70 – 80  | 78.3  | 76.5  | 77.3  |
| Air chamber diameter, mm                 |          | 18.0  | 20.0  | 19.0  |
| Hats units                               | < 75     | 93    | 87    | 88    |
| Protein index, %                         | 6 – 10   | 11.8  | 9.5   | 9.9   |
| Yolk index, %                            | < 40 – 50| 52.1  | 43.0  | 45.3  |
| Relative mass,%:                         |          |       |       |       |
| protein                                  | 58 – 62  | 70.9  | 60.6  | 63.6  |
| yolk                                     | 28 – 32  | 17.8  | 27.7  | 26.4  |
| shell                                    | 10 – 12  | 113   | 11.7  | 10.0  |
| Protein/yolk ratio                       | 1.8 – 2.5| 3.9   | 2.2   | 2.4   |
| Shell thickness, microns:                | < 330    |       |       |       |
| at the blunt end                         |          | 345   | 354   | 333   |
| at the equator                           |          | 376   | 367   | 351   |
| at the sharp end                         |          | 380   | 346   | 349   |
| average                                  |          | 367   | 356   | 344   |
| Number of pores, pores/cm² (average)    | 130 – 150| 126   | 136   | 134   |

Analysis of the data showed that the practically analyzed parameters of the quality of eggs correspond to the normative ones. The existing deviations are not related to metrological support. For example, the relative weight of the yolk is lowered. These violations of the quality of hatching eggs are associated with the young age of the bird. The shell thickness on average over the surface of the eggs is normal. But there are eggs with a thin shell in the blunt end zone (less than 300 microns). Thus, it can be stated that the existing technical means and devices for ensuring the quality of incubation and edible eggs have passed metrological verification and are functioning effectively.

3. Conclusion
At present, the strategy of behavior of any economic entity, including poultry, has changed. The focus is not only on maximizing profits with minimal resource consumption, but also on expanding the customer base through the production of quality products. [8]

The current quality management system in the industry made it possible to meet the requirements of buyers.

This system is based on a number of international and national standards that provide for the release of safe and quality products through the effective functioning of the poultry business model.

Within the framework of this model, the integrated process model of the QMS developed by the author is highlighted, which shows all the interrelationships of existing business processes, gives their brief description and substantiates the role of metrological support in the effectiveness of their actions. A map, algorithm and regulations of this process are given in detail, with their essential characteristics, and the value of metrological support of technical means and devices for obtaining high quality incubation and food eggs, which allow fulfilling regulatory requirements in accordance with standards, is shown. Thus, today the problem of more and more improved technical means and devices that ensure their uninterrupted and effective functioning is being actualized.
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