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Identificação dos requisitos críticos para registro de dados para rastreabilidade na avicultura de postura: um estudo com granjeiros do Município de Bastos-SP

Identification of critical requirements for data recording of traceability in laying poultry: a study with farmers from the City of Bastos-SP

Identificación de requerimientos críticos para el registro de datos de trazabilidad em producción de huevos: um estúdio com agricultores de la Ciudad de Bastos-SP

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Resumo

Com consumidores mais exigentes, a indústria de alimentos precisa se adaptar para atender a demanda por informações. A rastreabilidade é um sistema que possibilita obter todas as informações relacionadas a um produto, desde o início da sua cadeia produtiva até o consumidor final. O registro de dados é a primeira etapa do Ciclo de Vida dos Dados e dá suporte para o início da implantação de um sistema que seja capaz de rastrear as informações de qualidade dos ovos. Por ser um alimento muito consumido, a avicultura de postura brasileira necessita se estruturar de forma a cumprir requisitos de qualidade e informacionais. O objetivo desse trabalho é identificar os pontos críticos para coleta das informações de rastreabilidade dos ovos em granjas comerciais por meio de entrevistas, as quais permitem validar os requisitos identificados e a proposição de melhorias no processo de coleta de dados dos ovos. As etapas de manejo sanitário na cria e recria, controle de insumos, coleta de ovos, classificação de ovos e identificação do produto foram apontadas como etapas críticas para implantação da rastreabilidade.

Palavras-chave: Avicultura de postura; Rastreabilidade; Coleta de dados.

Abstract

More demanding consumers pressure the food industry to attend the increasing demand for information. Traceability is a system that allows to gather information related to a product, from the beginning of its production chain to the moment of consumption. Data recording is the first stage of the Data Life Cycle, and supports the implementation of a system that is capable of tracking egg quality information. Egg is a widely consumed staple food and the Brazilian poultry production needs to be structured in order to attend quality and informational requirements. The aim of this paper is to identify the critical points of the traceability information gathering of eggs in commercial farms. The interviews carried for this paper allowed to validate the identified requirements, and to propose improvements in the process of collecting data of eggs. The steps of sanitary management in breeding and rearing, control of inputs, eggs collection, eggs classification and product identification were described as the critical steps for the implementation of traceability.

Keywords: Laying poultry; Traceability; Data collection.

Resumen

Con consumidores más exigentes, la industria alimentaria necesita adaptarse para satisfacer la demanda de información. La trazabilidades un sistema que permite obtener toda la información relacionada con un producto, desde el comienzo de sucadena de producción hasta el momento del consumo. El registro de datos es la primera etapa del Ciclo de Vida de los Datos y respalda el inicio de la implementación de un sistema que es capaz de rastrear la información de calidad del huevo. Como se trata de un alimento de gran consumo, la producción de huevos de Brasil deben estructurarse para cumplir con los requisitos de calidad e información. E neste sentido, el objetivo de este trabajo es identificar los puntos críticos para la recolección de información de trazabilidad de huevos en granjas comerciales. A través de entrevistas, este trabajo tiene como objetivo validar los requisites identificados y proponer mejoras en el proceso de recopilación de datos de los huevos. Como resultado de las entrevistas, los pasos del manejo sanitario en la cría y la recría, el control de los insumos, la recolección de huevos, la clasificación de los huevos y la identificación del producto se describieron como pasos críticos para la implementación de la trazabilidad durante las entrevistas.

Palabras clave: Producción de huevos; Trazabilidad; Recopilación de datos.

1. Introduction

Consumers are increasingly demanding information about the products they consume. The food industry needs to adapt to meet this new market demand. A system that is able to trace the production steps of a food product is able to provide different information about the purchased product, including cases of recall (Badia-Meliset al., 2015).

The traceability system has been increasingly implemented in food industries (Pizzutiet al. 2014) in order to collaborate with the availability of this information that consumers are demanding, and contribute to the collecting of data related to the product. In cases of product recall, intoxication or any problem caused by poor processing, or any failure in the production process, the traceability system can help to detect any issue and ensure that the appropriate solutions are taken quickly, without the consumer being harmed (Tenget al. 2016).

Integrating all links in the production chain through the registration link is one of the major difficulties in implementing the traceability system (Zhao et al. 2017; Badia-Meliset al., 2015, GoglianoSobrinhoet al. 2010). These updated and linked records are essential to

obtaining the necessary data to feed the system.

On the other hand, obtaining the important data for the traceability system within the farms, the stage in which the greatest transformation of the egg occurs, from obtaining it through the laying hens, to the process of collecting, sorting, packaging and shipping, take place in the production and processing stages. Thus, it is essential to initially understand its mechanism. It is known that the stage prior to the process is often carried out on the farm itself (Donato et al. 2009; Faria, 2013).

In addition to the inability to link records between food chain links, Pizzutiet al. (2014) also reported that there is inaccuracy and errors in the records, which causes delays in obtaining data. That reveals the importance of systematized information across the chain and points out as the main problem the lack of common standards for coding and information management between the chains.

In the context of egg production, which are unitary food products, this classification is not commonly observed. Ringsberg (2014), Aung & Chang (2014) demonstrated the importance of food labeling, especially single labeling, for unitary food products, and an efficient packaging system for these typed of food.

Traceability is a prerequisite for implementing quality systems that can be used in food industries. Systems such as HACCP (Hazard Analysis and Critical Control Points), GMP's (Good Manufacturing Practices) and SOP (Standardized Operating Procedure) or SOHP (Standard Operating Hygiene Procedure), are important quality programs that, if well implemented, guarantee food safety (Mazzuco, 2012). Given this, the market is seizing tools that enable the intensive use of data in food safety and is announcing the beginning of paradigm shift stages (Kovacet al. 2017).

Thus, alternatives for data collection, storage and retrieval are available on the market and, according to Sant'Ana (2016), all this data availability allows new bridges to be built between users, due to the high demand for information.

Data collectingis the initial phase of the data acquisition process and it outlines all the strategies, mechanisms, methodologies, and tools that will make it possible to obtain the necessary data to feed an information system. In this phase, data sources are identified, and the characterization of the collecting takes place through a data supply process that can be continuous or punctual. In this last case, the rhythm of the collectingis identified through the time in between data measurements (Sant'Ana, 2016). Sayão and Sales (2015) mentioned that data can be obtained through manual observations, by sensors or equipment.

The data collecting stage is permeated by 6 pillars: privacy, integration, quality,

copyright, dissemination, and preservation. The objective is to ensure that the data collected is of quality, with the due privacy of the collector and responsible company, that allows integration with other databases and that the right to that information is guaranteed so that it will be available in future accesses (Sant'Ana, 2016).

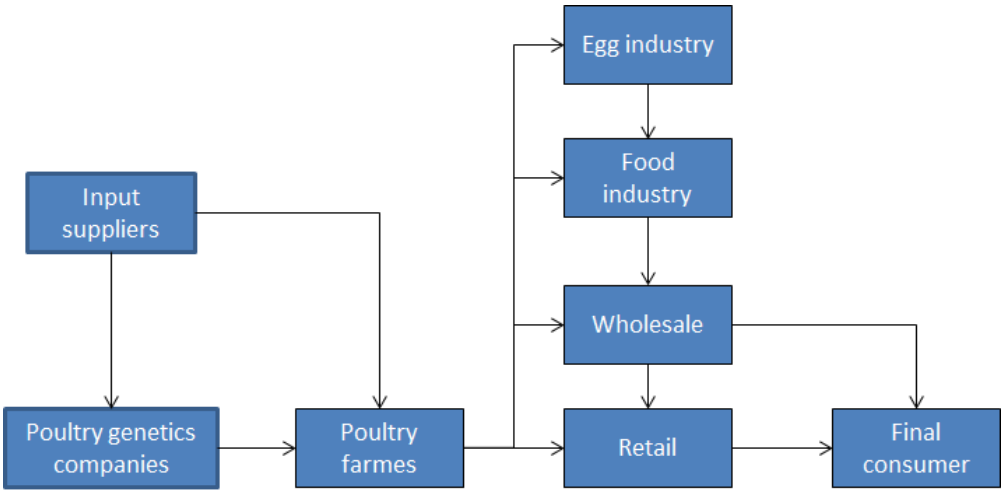
In this sense, the objective of this work is to identify the critical points for data collecting for traceability of eggs in commercial farms. Through interviews, it is aimed to validate the identified requirements, and, in the end, propose improvements in the process of data collecting of eggs.

2. Methodology

This research was qualitative in nature, as it occurred through research with farmers, who provided descriptive reports on egg production and data records, which the researcher intuitively analyzed and systematized (Pereira et al., 2018).

The production chain was divided into stages in order to know preliminarily the general context of application of egg traceability. The identification of the steps that make up the egg production chain takes place according to Figure 1.

Figure1. Layout of the egg production chain.



Source: created by the authors.

Figure 1 identifies the agents that are part of the egg production chain and that assume responsibilities in the activities of collecting data of interest for traceability. The proposal is to evaluate what is the important information for data collecting and what would be the difficulties of obtaining this information in the farms. In the case of the target region of this

study (Bastos/SP, Brazil), the stages of egg production and processing are understood as farms.

The geographical delimitation of this study will be restricted to farmers in the city of Bastos/SP, Brazil, taking advantage of the fact that this is an important center and reference in egg production (Faria, 2013).The survey of field data was carried out by applying a survey to farmers in order to determine the critical points for implementing traceability in establishments.

To generate a data collecting base to feed the traceability information system, there is a need to conduct research on how to feed the information system through data collection. The main questions were defined in an action plan by Phillips (2016), and adapted to the need of obtaining traceability data to the system on the farm, according to Table 1.

Table 1. Main issues considered in the survey conducted with farmers.

	Drivers
1	What are the most important data needed to feed the system?
2	Where are the sources for this data?
3	How can data be collected?
4	Who is responsible for collecting the data?
5	What format is it in (unit of measure)?
6	Is there a need to process the data so that it is in the desired format?
7	How to identify its origin?
8	Do collectors have the right or permission to collect this data?
9	Is there a need for data recovery at a future time?
10	How long will it be stored?

Source: adapted by the authors, based on Sant'Ana(2016).

After the completion of the action plan, it is necessary to include specific requirements for the egg production system, information regarding the certification of the traceability system and information required within the production chain.

In this sense, Technical Circular No 49 was used, and GEPP (Good Egg Production Practices) are laws that address good practices for the production process within poultry farms in the previous and subsequent stages. It was also used the Normative Instruction 56 of 2007, which establishes procedures for registration, inspection and control of poultry

establishments, Normative Instruction 36 of 2012, which complements this information, and Collegiate Board Resolution 24, which deals with recall procedures in the industry.

In addition, EU Regulation 931/2011 was used, which outlines as points to be verified in the traceability system: a) exact description of the food product kind; b) volume or quantity; c) name and address of the shipping company; d) name and address of the owner of the shipping company; e) name and address of the product's destination; f) name and address of the owner of the destination company (if different from the previous item); g) batch or shipment reference; h) date of dispatch.

Complementing this information, ISO 22005: 2007 was used, which specifically deals with traceability in food and beverage production chains and includes the registration of final batches, delivery records at each stage of the chain and the initial route since its production.

In this way, the main traceable quality and information requirements were identified, a questionnaire was elaborated and interviews with representatives of the farms were carried out in order to understand the points where the application of traceability is flawed, where information can be lost in the chain, the difficulties to implement related to obtaining data, among other questions.

In order to understand the identified difficulties, Table 2 presents the pillars of the data collecting stage, understood by: privacy, integration, quality, copyright, dissemination and preservation, which were fundamental due to the characteristics of production and the ability to record information observed in the visited farms.

Table2. Description of the pillars that make up the data collecting stage in the data life cycle.

Pillars	Definition
Privacy	Moment when it is necessary to identify in the sources used, the aspects that can configure the breach of privacy of people or institutions related to the collected data, and that could result in a future liability from the database obtained, compromising the next phases of the life cycle.
Integration	The integration must be a concern of the collectingphase through the identification and validation of the attributes that will be responsible for the identification of each record and its correspondents in the other databases. It is necessary to integrate the databases to make the collected information available.
Quality	Identification of elements that allow the perception of the quality of the collected data. Attributes such as source of data, collectingmechanisms, guarantee of physical and logical integrity are fundamental for the reliability of the collected data.
Copyright	Assignment of responsibility for the data source so that there is no disrespect for copyright linked to the collected data. The legal framework that supports the legality of accesses must be respected, since there may be companies and resources involved in this process.
Dissemination	The dissemination or future access is considered from the collecting stage to enable the greatest possible gathering of information. Attributes that are not directly linked to the current need can be included in the planning of the data collecting structure, making them available during the data recovery phase.
Preservation	In data preservation, additional data and characteristics of collecting devices may be included, enabling data to be identified more broadly, allowing for not only preservation, but also use, even after changes in the structure through the evolution of collecting devices.

Source: adapted by the authors, based on Sant'Ana(2016).

Sampling was intentional, in order to obtain true information that will contribute to the completion of the proposed steps. Table 3 identifies the subject addressed in each driver addressed during the interviews.

Table 3. Subjects covered in the interviews regarding the collecting of information in each of the production stages.

Question Nº	Topics covered
Q1	Health management in the breeding and recreating phase
Q2	Lineage of birds
Q3	Control of inputs on the property
Q4	Division of birds by batch
Q5	Vaccination of birds
Q6	Health monitoring of the farm
Q7	Poultry feed
Q8	Collecting of eggs from sheds
Q9	Classification of eggs
Q10	Biosecurity
Q11	Product description, batch identification, shipping date, shipping company data, destination company data.

Source: created by the authors.

Ten interviews were carried out with farmers between the months of September and October, 2018, and through the exploration of the data, it was possible to understand the stages where the greatest difficulties are found for the implementation of the system.

3. Results and Discussion

The interviews carried out represent approximately 15% of the total producers in the city of Bastos/SP, Brazil, and the data were compiled in Table 4. The markings were made where the interviewees pointed out greater difficulty in obtaining data, in executing the item and the achievement of traceability itself.

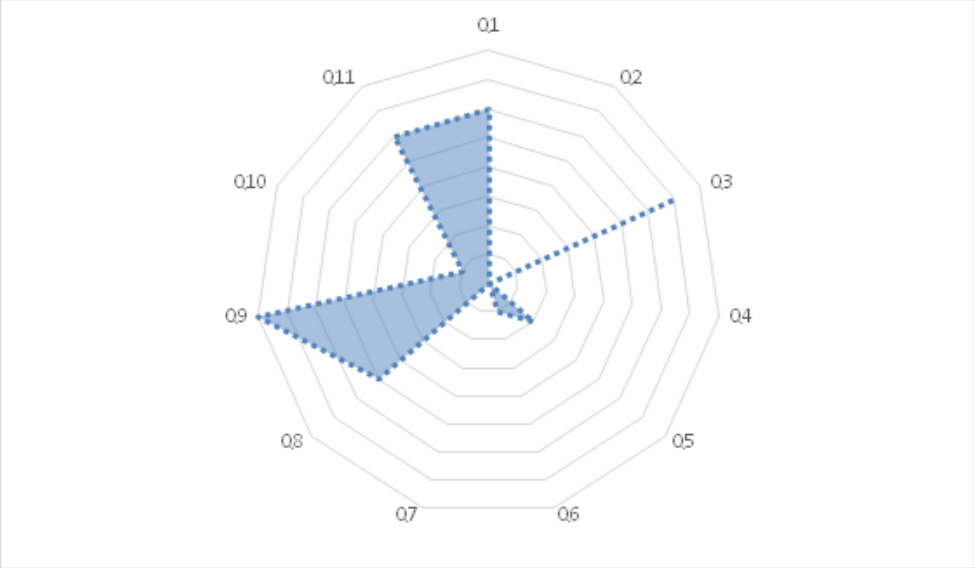
Table 4. Greater difficulties pointed out by farmers.

Farms	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11
1	x		x					x			
2	x		x		x			x	x		x
3	x		x		x	x			x		x
4			x					x	x		
5									x		x
6	x		x						x		x
7			x					x			x
8	x							x	x		x
9			x						x	x	
10	x								x		

Source: created by the authors.

The identification of each establishment is only illustrative, and the information transmitted during the interviews is confidential. Based on Table 4, the critical steps in the process of implementing traceability were determined, as shown in Figure 2.

Figure 2. Amount of respondents who declared it difficult to obtain information related to the matters contained in Chart 1.



Source: created by the authors.

According to Figure 2, the registration of information regarding sanitary management in the breeding and recreating phase (Q1), control of inputs (Q3), egg collecting (Q8), egg classification (Q9) and product identification (Q11) were determined as main critical points for a traceability process.

Regarding sanitary management in the breeding and rearing stage, it is observed that the farms present a record of different information, sometimes based on the production of food for the different stages of the bird life, sometimes based on the control of diseases in the herd. The availability of water and adequate food for each phase of the bird life is important in the development of uniform sexual maturity (EMBRAPA, 2006; Faria, 2013).

The recording of the information generated in the breeding and rearing stage is essential to the understanding of many diseases and behaviors presented by birds in production. In many cases, it was observed that the important procedures for attending this stage are performed, but as this information is not recorded, they end up being lost throughout the production process. It is observed that feeding in the breeding and rearing stage is carried out with greater control, while the availability of water is not carried out in the same way. The availability of water at appropriate temperatures and quantities makes the breeding and rearing stage more pleasant for animals (Donato et al. 2009; Faria, 2013, Amaral et al. 2016).

The input data are obtained in different ways and the information is insufficient to guarantee the tracing of the previous stages. It is possible to observe the monitoring of the levels of nutrients necessary to supply the needs of the birds through supporting analysis of nutritional information. It is, also, observed the adherence of suppliers as a control point, and the control of inputs based on purchases in large quantities for the supply of the farm during one year of work. In this case, supplier allegiance is not an adequate tool to guarantee the efficiency in the composition of the inputs. The purchase and storage for long periods of time can cause deterioration if the storage environments are not controlled (Donato et al. 2009; Faria, 2013).

The collecting of eggs can be carried out manually or automatically in the establishments and it is not possible to identify such differentiation of collecting systems in the later stage, understood as the classification of eggs. In addition, the recording of data in this stage is carried out in a rudimentary way, since there is a mixture of eggs from all the production warehouses. It is a critical point common to 90% of respondents because there is no possibility of segregating the production of each shed.

Each shed has a lot of birds that carry a range of different information, such as lineage, poultry feed, and disease incidence. At this moment, there is a break in the information link

(Zhao et al. 2017; Badia-Meliset al., 2015, Gogliano Sobrinho et al. 2010), and a non-fulfillment of the important systematic requirements to organize the data collecting system pointed out by Machado (2000), which are :i) the batches produced must not be mixed; ii) any movement must be registered in the traceability control records; iii) the production documents must follow the production steps with records of all the carried out processes. In farms where the collecting system is only automatic, there is no possibility of egg segregation.

Segregation can be a solution, however the interviewees pointed out that to carry out this process it is necessary to extend the work shifts, making the production line idle during many periods of the day, causing an increase in production costs.

Another possibility would be to identify eggs at the time of leaving each shed using equipment that colored part of each product unit with non-toxic paint, in the case of automatic egg collecting systems. For manual systems, trays of different colors are used in the collecting stage. Another way would be to attach an agricultural implement to the tractor that collects eggs in the sheds, and in that implement, insert the equipment that identifies the eggs.

The mixing of eggs, mainly in the automatic collecting, is an important demand that the productive sector needs to develop, both in technology, to solve the problem, and in organization of the production lines, including training of personnel in order to understand the importance of the process. It is fundamental, to improve processes, that there are segregated lines with duly identified product processing, organization of the distribution of the batches in the warehouses that allows the passage through the classification following an order, and the grouping of the same information in a determined stage.

The egg classification stage can be accompanied by the insertion of a tracing code on the eggs, observed in only 20% of the interviewed farms. It was also observed the use of technologies for recording the information generated in each product unit, which can carry different information within the production process, but that, ultimately, converge to information regarding the compliance with the norms regarding egg production in Brazil. Thus, the formation of batches takes place according to daily production, using either the Julian code to identify the formed batches, or an internal identification established by the farm. To record the batch identification on the eggs, a type of Inkjet recording equipment is used. On the other hand, without the use of a tracing code printed on the egg, there is a segregation of daily production, observed in 80% of the interviewees. The date of manufacture is used instead of batch identification. Differentiation of the egg type is identified in the secondary and tertiary packaging stages.

In this sense, after the batch classification and identification processes, time

information can be added to the traceability code, when using the printed tracing code, generating more information for the traceability process, increasing the possibility of retrieving larger amounts of data.

Behind each batch number there must be a set of documents that contain information necessary for the production process (Sant'Ana, 2016). The degree of information detail determined by the size of the TRU's (Traceable Resource Unit) varies according to the traceability purpose. The processing step is the chain stage that requires the highest degree of information detail, so the number of requirements placed on a chain traceability process will be less than the number of requirements for an internal traceability process (Moe, 1998).

In order to categorize and understand the functionality of a traceability process, Hobbs (2004) and Rhensingsberg (2014) identified three categories of food traceability systems that are based on their functionality: i) “ex post” reactive systems that trace contaminated food or ingredients in case of contamination and thus minimize social costs (costs with reimbursements for the injured individuals); ii) systems that assign responsibility and; iii) “ex ante” information systems that provide quality verification information. In the case of the interviewed establishments, it can be identified that they assume a role of providing quality verification information, understood by the (iii)“ex ante” category. During the interviews, concerns about customer complaints that generate social costs were not mentioned. It was only communicated concerns about costs with replacement of products, which were often unnecessary. Responsibilities were also not assigned to employees who carry out the activities of each area questioned.

Information such as product description, batch identification, shipping date, data of the shipping company and the destination company of the product sold were verified in all interviewees. Product identification information is essential for making informational data available. They are the points to search for traceability information, in accordance with the EU Implementing Regulation No 931/2011 and RDC 24, 2015, which highlights the importance of recording all related events in the production process.

The identification of the product in all packaging is important for the moment of tracing (ANVISA, 2015). The lack of this information makes it impossible to take action in order to solve a problem.

The collecting of all data is made by employees of the administrative sector, through the insertion of information on tablets with direct availability in the company's data control system, directly in Excel spreadsheets or in paper spreadsheets. In this sense, some information is recorded and preserved; others are verified, but not recorded and preserved.

Access to this data is allowed to the internal employees inside the farm and external official bodies, when required.

From the perspective of Information Science, the pillars of copyright and privacy, shown in Table 5, are less relevant to the study. The pillar of integration is of fundamental importance, as it allows the internally collected data to be integrated between the stages of production, thus ensuring greater communication and availability of information between the areas.

The pillar of information dissemination is related to the possibility of future access to information, including integration with other databases. Thus, it is necessary that the data collected is accurate and correctly collected (Pizzutiet al. 2014).

It is known that the quality of the information obtained in this process is of fundamental importance to feed the traceability process. Food safety drove improvements in the systems for monitoring production processes, along with the process of expanding the food supply chain. Quality information is essential to achieve this expansion (Zhao et al. 2017, Gogliano Sobrinho et al. 2010). For information to reach consumers, it needs to have quality attributes that guarantee their future access (Pizzuti et al. 2014).

With regards to preservation, it is a sector demand for data storage time, which is important for there to be standardization among establishments and for the record links that are important to the system to not be lost (Zhao et al. 2017; Badia-Melis et al., 2015, Gogliano Sobrinho et al. 2010).

In legislation aimed at the egg production chain, such as Instruction No 56, 2007 and Normative Instruction No 36, 2012, are referred the data storage time for three years only for the results of tests for influenza, Newcastle avian disease and Infectious Avian Laryngotracheitis, diseases that affect birds (MAPA, 2007; MAPA 2012). According to those documents, data related to pest control in the establishments must be stored, however it is not mentioned how long to keep the record until disposal.

In addition, insufficient information, and the lack of information quality in some stages of production is something to be wary of. For some establishments, there is this lack mainly in the control of inputs and in the registration of vaccinations. It is essential to make a note of this information, regardless of the medium in which it was chosen by the company, on paper or computer system. Writing down the information of an industry's routine shows how prepared it is to implement a traceability process where, at any time it is necessary to access information, it is available for consultation (Moe, 1998).

For the implementation of the traceability process to become feasible, it is important to consider two possibilities: when using an automatic data collecting system, it is important to keep the equipment that feeds the system calibrated, in order to avoid measurement errors and thus flaws in information records. On the other hand, in manual data collecting systems, it is necessary to improve the personnel through training that highlight the importance of correctly collecting data from the production process.

In this sense, in addition to providing guidance to employees, it is necessary to provide guidance to farmers that contemplate the most important information to be recorded at each critical stage of the production process. It is important that data collecting is carried out in a standardized manner in all establishments, as shown in Table 5.

Table 5. Suggestion of information to be collected in the critical stages of the production process to feed a traceability system.

	Critical steps	**What to register?**	**How often?**
Q1	**Health management in the breeding and rearing stage**	Quantities used in the food formulation, with date of production and indication of batches* of all used ingredients	With each new formulation
		Destination shed with identification of lineage and birdage	With each supply of the warehouses
		Amounts consumed and consumption changes	Daily
		Silo cleaning procedures of warehouses and water tanks	Daily
		Aviary temperatures	Twice a day
		Amount of consumed water	Daily
		Analysis of consumed water	Monthly
		Bird development	Daily
		Atypical events occurred during the stage	-
Q3	**Control of inputs on the property**	All inputs received by the farm	Every reception
		Establishment of origin	Every reception
		Amount received	Every reception
		Expiration date	Every reception
		Batch or identification of origin of	Every reception

		loading	
		Visual conditions for receiving raw material	Every reception
		Analysis of mycotoxin in grains	Every reception
		Food formulation for each shed	Every formulation
		Vaccination records	Every application
		Atypical events occurred during the stage	-
Q8	**Egg collection**	Shed of origin	Every collection
		Bird lineage and age	Every collection
		Schedule	Every collection
		Collected amount (Not broken and broken)	Every collection
		Numbering of collected loads	All loads
Q9	**Classification of eggs**	Numbering of collected loads	Following the order of the collecting stage
		Occurrences of ovoscopy	Throughout the process
		Amount and classification of processed eggs	At every production stop
		Types of packaging used for the formedbatch	Daily
		Storage location of the packaged product	Daily
		Storage conditions for the packaged product	Daily
Q11	**Product Identification**	Product description	In all packaging
		Batch identification	In all packaging
		Date of manufacture and shelf life	In all packaging
		Shipping date	In all packaging
		Shipping company details	In all invoices
		Product target company data	In all invoices

Source: created by the authors.

Table 5 indicates which are the important items, among the critical points, and the frequency with which they should be registered, and also suggests that, among the stages of

collecting and classifying eggs a numbering of the collected batches is carried out and that this numbering follows during the classification process, in order to segregate products with similar characteristics during the production process.

It is worth mentioning that, in addition to these items, other important points in each production process can be inserted in the traceability system, depending on each establishment.

Finally, it is not always possible to establish the ideal traceability process between the stages of a production chain or even within an organization. According to Moe (1998), “when the loss of traceability of a product is inevitable, effective alternative control methods must be guaranteed”. In this sense, the lack of information observed in many stages of the productive process of the farms needs adjustment.

4. Final Considerations

The difficulty of identifying and tracing eggs is directly related to the process of collecting and classifying them, as they are unitary products. Furthermore, sanitary management in the breeding and rearing stage, input control and product identification information are essential for the traceability process to be feasible.

Controlling inputs is essential to know the steps prior to the production process, within the production chain. In the eggs classification stage, when there is mixing of eggs, the tracing code is necessary to allow the linking of the data gathered to the information that will be included in the end product in the next steps of the production chain.

In addition, with regard to data collection, many steps do not have data, others have insufficient data, so there is a need to standardize the important information for each requested item.

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