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IMPLEMENTATION OF THE GS1 GLOBAL TRACEABILITY STANDARD BY MARKET OPERATORS FOR THE PRODUCTION OF FLOUR CONFECTIONERY PRODUCTS USED USE OF CAROB POWDER

Abstract. Today, the need of introduction of a traceability system in Ukraine is being actively discussed in both the private and public sectors. On the one hand, this is required by national and international law, on the other hand, many years of experience of food companies in the EU, USA, Canada, Japan and other developed countries have proven the effectiveness of a well-established traceability system as a tool to protect business and consumers.

It is noted that the main goal of traceability is to respond quickly and find the source of the problem related to food safety, and to take all necessary measures to recall/withdraw from circulation a certain food product with minimal interference in the production process.

The company must have a traceability system that allows to identify consignments of food and their relationship to consignments of raw materials, packaging that is in direct contact with the product, packaging that is intended or expected to be in direct contact with food. The traceability system should include all records related to the process of making and distribution of products. Traceability must be ensured and documented prior to the moment of delivering to the customer.

The GS1 Global Traceability Standard has been found to include: identification of participants and trading partners, trade items and events; marking and/or methods

of labeling and/or affixing labels on goods; identification of types and types of data to be collected and stored; determination of methods and minimum requirements for keeping records and archival documents, in particular for their storage.

The sequence of development of the traceability system for the market operator for the production of flour confectionery products using carob powder is proposed. The requirements for applying the Global Trade Item Number (GTIN) to finished products are analyzed, which guarantees the assignment of a unique control number to each product.

Keywords: Global Traceability Standard (GS1), traceability system, flour confectionery, carob powder, Global Trade Item Number (GTIN).

Formulation of the problem. Currently, the nutritional value of flour confectionery is enriched with additional vitamins, dietary fiber, organic acids and minerals, using unconventional vegetable raw materials in the recipe.

A popular non-traditional vegetable raw material is carob powder, which is used to 100% replace cocoa powder in flour confectionery, which reduces the amount of sugar in the prescription composition of the product and enriches it with vitamins B, PP, E, C, A, D and minerals.

The multi-component composition of flour confectionery requires the proper functioning of the traceability system, which in the event of an unacceptable situation with the finished product, will ensure a quick finding of the cause of the problem and respond to the necessary measures.

Analysis of recent researches and publications. The study is based on the analysis of the international legal standard GS1 (Global Traceability Standard) and ways to implement a traceability system by market operators for the production of flour confectionery.

The purpose of the article: development of a traceability system according to the Global Traceability Standard for the flour and confectionery market operator using carob powder.

Presenting the main material. In 2002, the European Union adopted a package of basic laws (EU Regulations: № 178, № 852/2002, № 853/2002, № 854/2002, № 882/2002), which currently form EU food law. EU Regulation № 178/2002 [1], which is the basic food law for EU countries, sets out general requirements for food safety. It is determined that for the full implementation of the HACCP system it is necessary to implement a traceability system that covers all stages of production, processing and circulation of food or ingredients used for food production.

In Ukraine, traceability is regulated by the Law of Ukraine «On Basic Principles and Requirements for Food Safety and Quality» [2] and Order № 590 of 01.10.2012 (redaction of 25.12.2015) «On approval of requirements for the

development, implementation and application of permanent procedures based on the principles of the Food Safety Management System (HACCP)» [3].

The Global Traceability Standard was developed by the GS1 International Association, which is based on the requirements of the international standards of the ISO 9000 and ISO 22000 series, and is intended for use by various market operators [4].

It is known that in the process of making products there is a movement of three flows: material (raw materials, parts, components, etc.), energy (electricity, gas, steam, water, etc.) and information (data on raw materials), parts, energy, etc. on paper and other media that accompany the material flow). Therefore, a necessary condition for achieving an effective result in the process of identification and traceability throughout the production cycle, from the receipt of raw materials and components from suppliers to the shipment of finished products, is to ensure unambiguous connection of all flows in the production process. This means that the information flow must be continuous at all technological stages, objectively reflect changes in products in the production process, to preserve the original features of the object of identification.

As follows, for effective management of the process of identification and traceability it is necessary to implement a set of works, which includes the following interrelated areas: technical (technological) support; information support; organizational support. Information support and identification should include the development and implementation of information forms (supporting documents, other media), schemes of information flows and information registration points, as well as procedures for processing, systematization, storage and sale of data on identification objects, including machine methods of information processing [5].

The market operator needs to apply a step-by-step methodology for developing a traceability system according to the GS1 Global Traceability Standard, which includes three main stages: development of a traceability system; system construction; implementation and use of the system [6].

I stage. The development of a traceability system by the market operator for the production of flour confectionery using carob powder includes seven steps.

Step 1. Establishing goals and objectives of traceability of flour confectionery production. The market operator by order of the company approves the development of a traceability system for capacity. The following goals and objectives of traceability are set during the production of flour confectionery:

- identification and control of raw materials, packaging materials, semi-finished and finished products;
- identification and control of raw material suppliers and sellers;
- confirmation and guarantee of safety of finished products;
- rapid response of employees in the event of defective or inappropriate products;

- compliance with regulatory requirements during making products;
- effective development of the logistics department;
- ensuring that consumers are provided with truthful information about raw materials and the composition of finished products;
- ensuring prompt withdrawal of products from circulation in the event of a threat to consumer health.

Step 2. Gathering of traceability information on capacity. The operator of the flour confectionery market must have such information:

- agreements with raw material suppliers (supplier name, capacity address, telephone, e-mail, raw materials);
- documents confirming the quality and safety of raw materials (acts of examination, safety certificates);
- journal of acceptance of raw materials (date, time, supplier, raw materials and quantity, responsible, signature);
- journal of control of semi-finished products (date, time, semi-finished product, where, quantity, where, responsible, signature).
- scheme of organization of traceability of the technological process of production (all changes in the product, transportation, warehousing or write-off, combination of ingredients and mixing);
- agreements with product sellers (name of the seller, address of the place of sale, phone, e-mail);
- journal of finished goods (date, time, batch number, quantity and seller, responsible, signature);
- technological instructions for training personnel to record information to ensure traceability;
- journal of monitoring the effectiveness of the traceability system (date, time, effectiveness, responsible, signature).

Step 3. Analysis of the production process. The market operator analyzing in detail and draws up a scheme of organization of traceability of the technological process of production of flour confectionery products using carob powder.

Step 4. Identification of all participants in the production process. The operator of the flour confectionery market enters into an agreement for the supply of raw materials only with a supplier who has passed state registration. Identification of suppliers is carried out by checking the accompanying documentation and contracts. The raw material has a label indicating information about the manufacturer, time and date, storage conditions, expiration date.

In fig. 1. shown the detailed movement of carob powder from carob pods to flour confectionery, indicating the necessary documents for traceability.

Carob powder is imported from the Mediterranean countries like Spain or Italy, so it is mandatory to control the geographical origin of raw materials. In the table. 1. shows a sample receipt for sending carob pods from the farm for processing. The pod

processor during the acceptance of raw materials draws up a form of acceptance, which is given in table. 2.

Step 5. Establishing requirements for the accuracy of traceability data. The accuracy of traceability data is determined by two main parameters that make it possible to establish the optimal level of accuracy:

- 1) the level of identification of traceable products;
- 2) detailing with which traceability data is recorded.

The GS1 System uses the Global Trade Item Number (GTIN), which is clear and standardized. GTIN assignment rules ensure that each product variation is assigned a unique control number that is globally unique [7]. To implement a high-quality GTIN barcode, you need to perform 10 important steps, which are described in table. 3.

The market operator ensures the accuracy of traceability data, which is confirmed by the detail of the information received from partners. The quality of the data provided by each trading partner is crucial, as inaccurate data exchanged by trading partners can affect other processes, such as a recall request. Each ingredient is considered in questions: «Who?», «What?», «When?», «Where?» and «Why?».

Step 6. Designing an archive of traceability information. The market operator keeps written and electronic agreements with suppliers of raw materials, sellers of products. Logs of acceptance of raw materials, release of finished products, monitoring the effectiveness of the traceability system are numbered and bound for storage in writing. Information about a specific batch is recorded and stored for 5 years (if the shelf life of the product is less than 3 months, the information must be stored for 6 months).

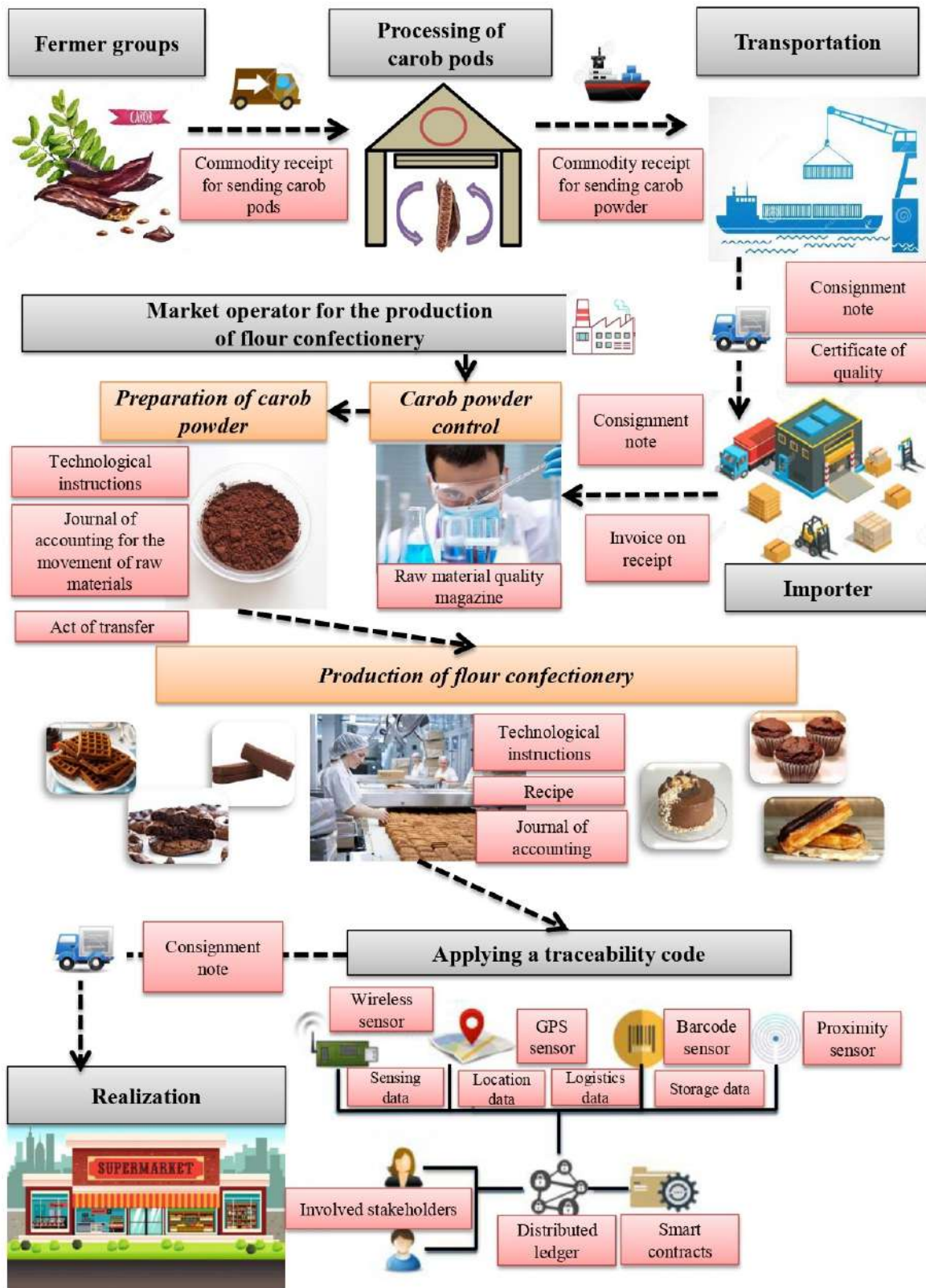


Fig. 1. Checklist for traceability for the use of carob powder
 Source: developed by the authors.



Table 1

Commodity receipt for sending carob pods

| Name _____ of _____ the _____ farm | Check № _____ Date ____/____/____ | | | |
|--|--------------------------------------|------|-------|-------|
| Address _____ | | | | |
| Contacts _____ | | | | |
| Name of the processor _____ | | | | |
| Address _____ | | | | |
| Contacts _____ | | | | |
| Amount | Description | Year | Price | Total |
| | | | | |
| | | | | |
| | | | | |
| Responsible for sending _____ (Name and signature) | | | | |
| Responsible for receiving _____ (Name and signature) | | | | |

Table 2

Form for taking carob pods

| Company Logotype | Getting carob pods |
|--|--------------------|
| | № _____ _____ |
| Controlled identification of raw materials | |
| Name of the farm | |
| EDRPOU code | |
| Address of the farm | |
| Date of receiving of carob pods | |
| № plots/origin | |
| Number of boxes | |
| Total weight (kg) | |
| Responsible for sending _____ (Name and signature) | |
| Responsible for receiving _____ (Name and signature) | |

Table 3

GTIN barcode implementation model

| Step | Title | Characteristics/Description |
|------|---|--|
| 1 | 2 | 3 |
| 1 | Get a prefix | Obtain a market operator prefix from a GS1 representative to create digits that are identification keys. |
| 2 | Assign a number | After receiving the prefix, the market operator begins to assign an identification number to the food products it produces. The GS1 Representative provides specific information on how many numbers can be assigned based on the length of the market operator's prefix. |
| 3 | Choose a barcode printing method | The market operator decides what information the bar code will cover: static or dynamic. When applying static information for a large batch of products, label printing is ordered in special printing houses. For the application of dynamic information are limited to a laser or thermal transfer printer in stock. |
| 4 | Select the «primary» scanning environment | The specifications for the type, size, placement, and quality of the barcode depend on where the barcode is scanned. There are three main scenarios of the scanning environment for trade items: scanning at the retail point of sale; in the general distribution; retail and distribution scanning. Knowledge of the location of the barcode scan, allows you to determine the correct specifications for its manufacture. |
| 5 | Select carrier for data | For a barcode trade item that is scanned at a retail outlet, a GS1 media must be used. If the barcode is printed with variable information, such as the batch number, you should use a character named GS1-128. |
| 6 | Choose a size | The size of the symbol in the design depends on the specified symbol, the place of its use and the method of printing. |
| 7 | Format barcode text | The text under the barcode is important because if the barcode is damaged or of poor quality at first, the text is used as a backup. |
| 8 | Choose a barcode color | The optimal color combination for the barcode symbol is black stripes with a white background, and the following variations can be used: <ul style="list-style-type: none"> • GS1 er be printed with multiple image tools (such as plate, screen, and cylinder); • GS1 barcode characters require a light background (such as white) to the left and to the right of the barcode; • in addition to a light background, you can also use "red" colors. It is known that in a dark room with red lighting, the text can almost disappear. This also applies to similar colors such as orange, pink, peach and light yellow. |

| | | |
|----|-----------------------|--|
| 9 | Choose a location | Symbol placement refers to the placement of symbols on a design. The packaging process should be considered and the packaging designer consulted to ensure that the symbol is not obscured or damaged (eg above the edge of the cardboard box, under the fold of cardboard, under the lid of the package). |
| 10 | Create a quality plan | Compliance with all the conditions for the implementation of the barcode ensures the creation of a quality bar code plan |

Step 7. Designing measures to use the necessary information of traceability. Documented traceability information is used when testing the system or having complaints about non-conforming products. Special measures are developed to identify exceptions and prevent incidents, ranging from simple queries to advanced data analytics. The following cases are envisaged:

- expiration of the certificate;
- compliance with temperature regimes during transportation;
- detection of counterfeit products;
- notice of recall of finished products;
- compliance with quarantine requirements during the production of confectionery.

II stage. Building a traceability system by a market operator for the production of flour confectionery using carob powder involves three steps.

Step 8. Analysis of shortcomings («as it is» versus «will be»). The market operator analyzes all stages of the technological process of confectionery production with cherub powder, comparing the current state of the process with the latest technologies.

Step 9. Installation of traceability system components. After the analysis of deficiencies, if necessary, the approval of the installation of new equipment or process.

Installation of metal detectors on production lines is insufficient to detect foreign objects in packaged flour confectionery, due to the fact that it allows you to detect only metal impurities.

The best solution for detecting impurities in packaged confectionery as a critical control point is the introduction of an X-ray system that allows you to save an X-ray image of each product package for further analysis. This makes it much easier to study the reason for the failure without damaging the packaging; improves traceability during the registration of each production batch; allows you to analyze the production process and improve it.

X-ray examination system MEKI™ (USA) [8] has a wide range of functions to ensure control of food safety and quality, namely content control (detection of the absence of parts of the food product); integrity control (determination of damage to



products in the package, which can be used, for example, in the technology of chocolate bars or cookies to detect crumbs formed during transportation); control of tightness of packing (detection of presence of a metal fastener, its tightness, for example, in packing for bread or nuts); filling control (detection of the amount or absence of filling). In fig. 2. the image of the X-ray examination system is given MEKI™.

Using the latest X-ray imaging and processing technologies, the MEKI™ system allows you to detect even the smallest particles of metals, stones, glass and various foreign objects, and prevent the sale of inappropriate products.

Step 10. Monitoring and testing. The flour and confectionery market operator enters into an agreement with a trading partner to test the tracking system, which undertakes to provide a final act on the results of testing the system.



Fig. 2. X-ray examination system MEKI™ [8]

III stage. The introduction and use of a traceability system by the market operator for the production of flour confectionery using carob powder involves three steps.

Step 11. Implementation of the system at the enterprise. A plan for the implementation of a capacity traceability system shall be prepared in advance and approved by the CEO. A documented procedure is being developed, in which a block diagram of the traceability system is given, indicating the technological stages of product production and registration of information in the relevant documents. Examples of control logs and checklists are given in the appendix to the procedure. The block diagram of the traceability system of raw materials and finished products in the production of flour confectionery using carob powder is shown in fig. 3.

The internal traceability system includes:

- training employees to manage documented information;
- development of successive block diagrams of technological processes of production, maintenance of systematic records, quick batch identification;

– management of flows of supply of finished products.

Step 12. Validation of documentation and staff training. The operator of the market for the production of flour confectionery using carob powder approves the company's management documents for the implementation of the traceability system and technical guidelines to ensure compliance with its standard.

Step 13. Monitoring and maintenance of the traceability system. Implemented traceability system in the production of flour confectionery with carob powder includes a procedure for monitoring the effectiveness of the system and maintenance if necessary.

The results of monitoring are recorded in the Journal of monitoring the effectiveness of the traceability system, which is given in table. 4. Inspections shall be carried out once a month by a sample method from the party.

Table 4

Journal of monitoring the effectiveness of the traceability system

| No | Date and time | Position of the inspecting person | System efficiency indicator | Signature | Analysis |
|----|---------------|-----------------------------------|--|-----------|--------------------------------|
| 1. | | Head of the production laboratory | % of defective raw materials | | Council for quality and safety |
| | | | % of defects during the technological process | | |
| | | | % of defective finished products by the consumer | | |

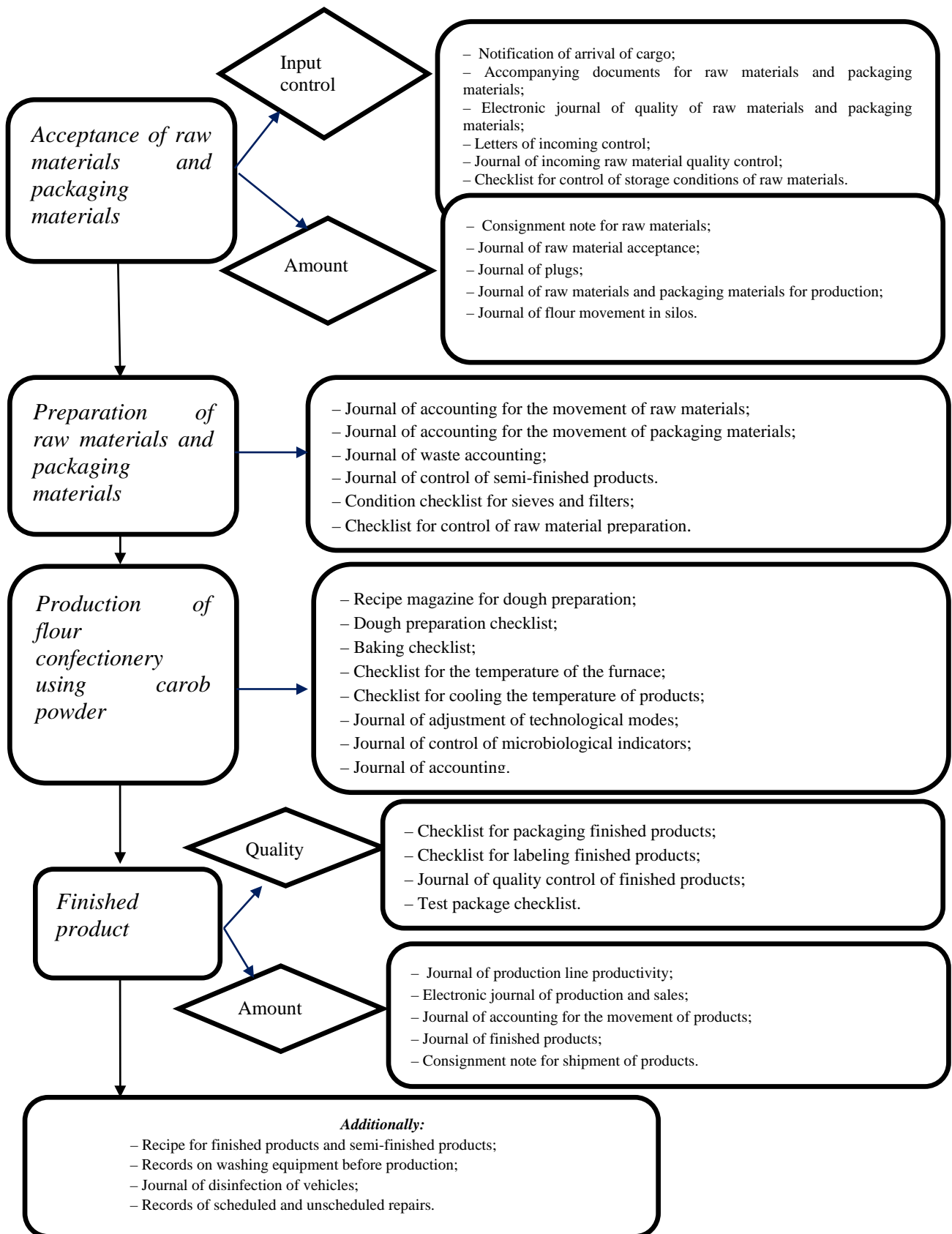


Fig. 3. Block diagram of traceability during the production of flour confectionery
 Source: developed by authors.

The basic conditions of traceability are met through:

- clear labeling;
- accurate records of documented information;
- clarity of identification data;
- observance of bar coding of products and indication of batch number;
- quick access to the information from archive.

Provision of information on raw materials, materials used for the manufacture of identified non-compliant products, analysis of technological processes to identify deviations, as well as obtaining all information on this batch of products should take place within 2..4 hours. The speed of detection of nonconformities confirms the effectiveness of the traceability system.

Conclusions. The introduction of a traceability system is an important element in ensuring the safety of finished flour confectionery. The traceability system will reveal the presence or absence of certain components of the product, will help the consumer to obtain information about the raw materials used.

The developed traceability checklist for the use of carob powder is easy to use for all operators of the flour confectionery market. An important step in implementing a traceability system for the market operator is to develop a documented procedure with a complete analysis of the technological process of production of flour confectionery and construction of a flowchart for easy acquaintance of capacity employees with information.

The unique product barcode provides quick identification and receiving data of confectionery products. Regular monitoring of the traceability system is necessary to confirm the effectiveness of the system and confidence in the proper operation of the information archive.

References:

1. Guidance on the Implementation of Articles 11, 12, 14, 17, 18, 19 and 20 of Regulation (EC) №178/2002 on General Food Law. Conclusion of the Standing Committee on the Food Chain and Animal Health of January 26, 2010.

2. Zakon Ukrainy Pro osnovni pryntsyipy ta vymohy do bezpechnosti ta yakosti kharchovykh produktiv: vid 21 bereznia 2021 roku № 771/97-VR [Law of Ukraine on the basic principles and requirements for food safety and quality of March 21, 2021, № 771/97-VR]. *Vidomosti Verkhovnoi Rady Ukrainy – Information of the Verkhovna Rada of Ukraine № 19*, pp. 5-6 [in Ukrainian].

3. Nakaz № 590 Pro zatverdzhennia vymoh shchodo rozrobky, vprovadzhennia ta zastosuvannia postiino diiuchykh protsedur, zasnovanykh na pryntsyypakh Systemy upravlinnia bezpechnistiu kharchovykh produktiv (NASSR): vid 01 zhovtnia 2012 roku [Order № 590 On approval of the Requirements for the development, implementation and application of permanent procedures based on the principles of the Food Safety Management System (HACCP) of October 1, 2012]. *Ministerstvo ahrarynoi polityky ta prodovolstva Ukrainy – Ministry of Agrarian Policy and Food of Ukraine*, pp. 10-12 [in Ukrainian].

4. Global Traceability Standard GS1 Release 2.0. (2017). www.gs1.org. Retrieved from: <https://www.gs1.org/standards>.



5. Zhyhailo, O.M. (2014). Vykorystannia tekhnolohii Data mining v avtomatyzovanii systemi prostezhuvanosti [Use of Data mining technology in an automated traceability system]. Avtomatyzatsiia tekhnolohichnykh i biznes-protseviv – Automation of technical and business processes, 3, 30-38. Retrieved from: file:///C:/Users/User/Downloads/VIKORISTANNA_TEHNOLOGII_DATA_MINING_V_AVTOMATIZOVA.pdf [in Ukrainian].

6. Bozhko, A. & Usatiuk, S. (2022). Applying of the Global standard of traceability system GS1 by the operators of the market's of production of food products. Abstracts of Papers: *The XXI International Scientific and Practical Conference «Actual priorities of modern science, education and practice»*, (pp. 759-761). Paris, France.

7. Food Traceability Guidance. (2017). Food and Agriculture Organization of the United Nations. Santiago. www.fao.org. Retrieved from: <https://www.fao.org/3/i7665e/i7665e.pdf>.

8. Sait kompanii «Mekitec» [Company website «Mekitec»]. www.mekitec.com. Retrieved from: <https://www.mekitec.com/food-quality-control/> [in Ukrainian].