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Traceability for Food Safety: the case of a sugar factory and alcohol distillery plant

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Abstract

Food contamination such as mad-cow disease (BSE) and Avian Influenza (H5N1), is imposing new concepts for the production, distribution and marketing of food. A common feature of this problem is that the cause and focus of contamination were not detected in the short term, which highlights the need for greater control over product information and processes from origin to consumption. This growing concern has stimulated the adoption of mechanisms for identification and traceability. The objective of this research is to discuss the importance of traceability to identify potential sources of contamination or contaminated products in the food chain. The research is based on the case study in a large granulated sugar producer in Brazil, which has a tracking system for agro industry products in operation over the last five years as an aid to the food safety management system. The national sugar-alcohol sector was chosen due to its leadership in production and exportation of sugar cane. Traceability plays a fundamental role in ensuring food quality and must be agile, accurate and reliable in order to provide reassurance to the consumer. This paper shows the ability of the studied traceability system to identify the source of a chemical contamination verified in the final product analysis or the identification of contaminated product when a fault occurs in the decanting process.

Keywords: traceability, sugar, Brazil, case study, agro industry.

1 Introduction

Since the 90´s, legal requirements and disputes involving food contamination and issues generated by the mad cow disease (BSE), genetically modified food (GMO) and the risks of proliferation of Avian Influenza (H5N1) are imposing new concepts. A high quality food has to be safe, which means it cannot cause health problems (Machado, 2005).

According to Meuwissen et al. (2003), these scandals involving food contamination had a common factor: the cause and the focus of the contamination were not identified within a short period. The consequence of such episodes triggered suspicion about the true safety of food in regards to the production and storage of it.

On the other hand Silveira et al. (2006) points out that the concerns regarding food safety and the current requirements and tendency of the consumer cause a demand for information from the start of production to the final consumer. However, to ensure and transmit information about the production process, it requires coordinated actions in the agribusiness supply chain; demanding a structure of management of production systems appropriate to these needs.

Nevertheless, according to Machado (2005), the growing concern about food safety has stimulated, in particular, the introduction of identification and traceability´s mechanisms. Therefore, this paper aims to discuss the importance of traceability in identifying potential sources of contamination or contaminated product in the food chain and to demonstrate through a case study how the traceability system for crystal sugar of Usina São José da Estiva S/A is capable of helping its food safety management system.

The employed methodology was the exploratory-descriptive study through literature search and the use of secondary data from publications and results from researches on the specific issue (Vergara, 2007). Various sources, such as, books, scientific articles, master´s dissertation and standards were used.

This study was based in a qualitative research, therefore, the evidence of the relationship between the management systems employed and the obtained results were only sought for, without concerns about statistic tools. It assumes the shape of a case study and dada collection. The case studies have characteristics of evaluation which allow exploring the possible connections of intervention in real life. It´s the chosen strategy when analyzing contemporary events because it allows direct observations of the studied events and of the interviews of the people involved in them (YIN, 2003).

The Industry São José da Estiva was chosen because it has a system of safety of food management implemented more than five years ago and because of its importance of the sugar and alcohol sector for the Brazilian economy: "Brazil is the largest manufacturer of sugar of sugar cane in the world, with the lowest production costs and also the largest exporter of the product". (ÚNICA, 2008)

2 Food Safety

Food safety refers to the use of certain measures that allow the entrance control of any agent that promotes risk to the consumer´s health or physical integrity. Thus, it´s a consequence of the control of several stages of the production chain, from farm to fork (Lima, 2009).

From the year 1990, the importance of the quality and safety of the food increased significantly among consumers, especially Europeans. This concern is related, mostly, to serious incidents of food contamination which caused intoxication, infections and death of several people around the globe (Vinholis; Azevedo, 2002).

In face of this scenario, public and private actors start to instigate more strict policies and measures of control for the production and importation of food, where the introduction of identification and traceability systems, adherence to standards, protocols and certification by third part gained momentum with the intention of providing greater control, and mainly, to avoid or minimize the risks associated with consumption of contaminated food (Leonelli, 2007).

According to the same author, in an international scope, the regulation of safety standards for food is institutionalized, initially, from the determinations of the Codex Alimentarius, the international code aimed to guide the food industry for protecting the consumers´ health, created in 1963, by the initiative of the United Nation Organization for Food and Agriculture (FAO) and by the World Health Organization (WHO).

In 2000, the Commission of the European Community published the White Paper on Food Safety which leaded to the origin of General Food Law in 2002. Through this measure the European Community establishes principles and general standards seeking food safety, where the need for identification and mandatory traceability is one of the main technical requirements. Since then, some European countries have tried to develop programs and coordinated actions with the private industry – in a communitarian scope – for different productive chains in order to fulfill the demands of the General Food Law (Sarig, 2003).

Furthermore, the International Organization for Standardization (ISO) edited a set of standards which establishes the requirements for the Management of Food Safety Systems, published on September 1st, 2005. The standard ISO 22000:2005 harmonize the requirements for a global approach of food safety, which will facilitate the implementation of HACCP systems (hazard analysis and critical control points), according to the principles of the Codex Alimentarius, independently of the country or product type. Within the series ISO 22000, the standard ISO 22005 deals specifically about the traceability of the animal and human´s food chain.

3 Traceability

According to the standard ISO 8402, the concept of identification and traceability consists in the ability to trace the history, application or location of an item using information previously recorded.

Pallet (2003) defines traceability as the management of information by the continuous synchronization of flows of goods and related information. He classifies the traceability according to the logistic of the product, such as the capacity to follow it in time and space, and according to the content, such as the capacity to provide all information about the life of this product. The same author still defines the principle of traceability as the process to ensure the maintenance of the characteristics of food providing safety and quality throughout its life flow. As far as the goals are concerned, he describes that reliable information subsidize a safe labeling, providing reliability to the food. Labeling is also a tool to point out the quality of a regional product protecting a captive or promising market.

Vinholis & Azevedo (2000) define:

> "a system of traceability, computerized or not, allows to follow, track information from different types (refered to the process, product, staff and/or service), the downstream or upstream of a chain link or from an internal department of a company. The traceability allows a history of the product, and the complexity of the content depends on aimed goal. This goal can be affected by the adopted strategy and by the external environment in which the company is inserted".

According to Moe (1998), the systems of identification and traceability are supported by a comprehensive system of management of quality which purpose is to monitor the product attributes and/or process and, specially, to enable the return to the control phases throughout the production chain, by means of procedure and registries.

According to Grunert (2001) it must be part of the traceability system:

- Identification: identification of the products and standardization of information and of the parts which influence the quality of a product;

- Link: the management throughout the supply chain among the lots and logistic units happens because of the link generated by the own production;

- Registry: the data and the information recorded throughout the production and logistic process are tools which will bring real mapping conditions to the supply chain;

- Communication: the larger the association and alignment of the information with the physical flow, the larger will be the capability of management.

Therefore, in order to the traceability to be really effective it´s necessary for the process to be properly identified and documented, in such a way that allows the access to the history of the production, paths and changes that the product may suffer along the way until it´s final consumption. Some information about the production process need to the carefully cleared and followed (monitored), as well as, integrated to a proper information system. Techniques for enterprise modeling are essential tools for survey information of the production process and the determination of the sectors involved in the task of identification of the important points for the traceability of the products as well as the identification of its critic points and its possible undesirable changes (flaws or contaminations) in the change or formation process of the products (Souza e Campos, 2008).

According to Yugue (2003), besides the technical motives, there are three arguments which justify the use of traceability systems. The first one is that its use is an added value and a source of differentiation of the product through certification of origin and labeling. The second argument talks about the protection of exportation through precise and quick information and answers to the frequent questions about the conditions of manufacture and distribution throughout the production chain, knowing that mere suspicion can take to the rescission of many contracts and, evidently, hamper the closure of other contracts. The third argument is the relationship of trust that all companies must maintain with the consumers that are more and more conscious of its rights and prerogatives, demands and predisposed to recognize and value the posture of the organizations that respect them as citizens.

According to Juran & Gryna (1993) mentioned in Souza (2001), traceability has several purposes, such as:

- to ensure that only high quality products and components be part of the final product,

- clearly and specifically identify products that are different but that at the same time they look alike so much that they might be mistaken,
- to allow the return of a suspicious product in a safe basis, and
- to identify troubleshoot and take corrective measures at minimum price.

Machado (2000) defines the importance of traceability for the distribution and retail sector and for the food industry:

- it´s a competitive edge,
- strengthens the corporate image,
- assists in positioning the brand in the market,
- encourages competition by quality differentiation,
- improves the relationship with the suppliers,
- contributes to building the company´s competitive strategies and, therefore, start to define vertical structures of coordination.

And, finally, to the State, the author concludes that traceability:

- minimizes the risk of contamination and facilitates the identification of focus of issues of this gender,
- reassures de population and gives credibility to the State itself.

The traceability systems include the logistics traceability which makes de quantitate monitoring (location) of the products and determines as much as its origins as its final destination, and it´s substantially used for recall and discard, or to locate the origin of the product and it´s based on the geographical location of the logistic units. Qualitative traceability (of the products) means to follow it up to find out the qualitative failures and their causes, to identify the sources of quality deviation and to determine whose responsibility it is. As shown in figure 1 it may be either downstream or upstream. Downstream would be the identification of the products´ destination (from company forward) and the upstream would be the identification of the inputs and raw materials´ suppliers used in the development of the product. The traceability of the product is essentially based in the characteristics of the products (consumer´s unit), knowing that the internal traceability deals with the production and storage of the product within the company (EAN Brasil, 2003).

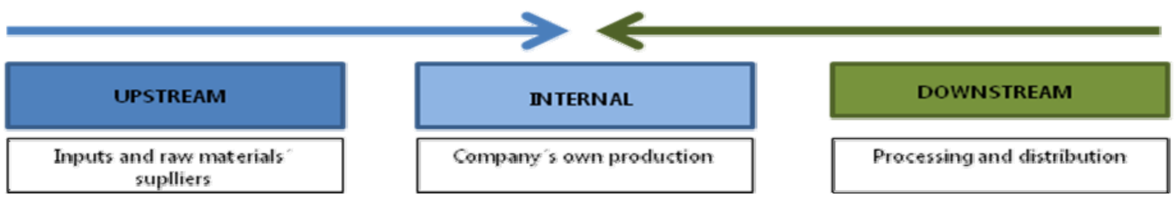

Figure 1: Traceability Classification. Source: Zanatta & Hendges, 2010

However, Leonelli (2007) ensures that a sized system which can be used to trace various "inputs" and processes, tend to be huge, complex and very expensive in order to satisfy each and possible goal. In this way, the company can determine the correct breadth, depth and precision of the traceability system that will be shared between the links and agents of the supply chain. On the other hand, the determination of the breadth, depth and precision of the traceability systems depends on the characteristics of the production process and, especially, of the goals of the traceability system being used (Golan et al., 2004).

According to Golan et al. (2004), such concepts can be defined as:

a) Breadth: describes the collected amount of information, including the steps and agents of the supply chain that will be embraced by the traceability system. For the authors, an information storage system that is able to catalogue all the attributes of the food production is not only expensive and complex, but also unnecessary. Therefore, the information to be collected will depend on the traceability system that is being used.

b) Depth: it´s understood as the system´s ability to follow the relevant information, either "tracing"(upstream) or "tracking" (downstream) of the place where it originated.
c) Precision: reflects how accurate the traceability system can locate the handling and/or relevant characteristics of a specific food. The level of precision can vary according to the goal of the traceability system.

Figure 2 summarizes the concepts shown on the work of Golan et al. (2004) and Opara (2003).

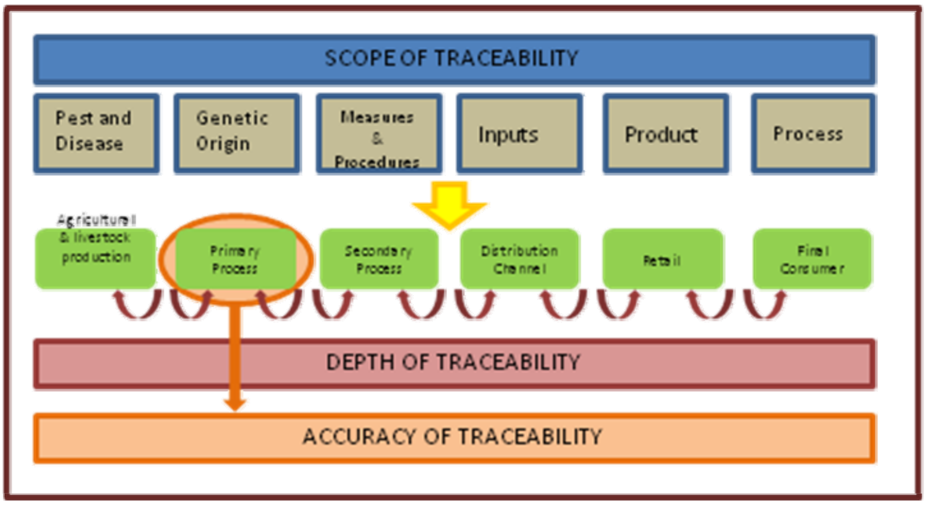

Figure 2: Sequence of concepts from Golan and Opara. Source: Leonelli (2007), from Golan et al. (2004) and Opara (2003).

According to Opara (2003), there are six important elements that, when worked together, constitute an integrated system of traceability for agroindustrial chains. The underlined elements of the author´s suggested typology are described below:

a) Traceability of product

The traceability of the product has the purpose to determine the physical location of the product in any level of the supply chain in order to facilitate the logistic and inventory management, the products´ recall and the information´s propagation.

b) Traceability of process

Traceability of process aims to verify the type and sequence of activities by which the product has traveled, including the stages of vegetative growth and post-harvest operations, trying to describe what, where and when it was done.

c) Genetic Traceability

In this type of traceability, they try to find out the genetics of the product, either from animal or vegetal.

d) Traceability of inputs

Traceability of inputs aims to determine the type and origin (characteristics and supplier) of inputs, such as: fertilizers, agrochemicals, irrigation´s water, information about the herd, feed, presence of chemicals and additives used in the preserving and/or processing of the raw material into new food products reconstituted products.

e) Traceability of pests and diseases

This kind of traceability is used for tracing the epidemiology of pests and diseases, also seeking to highlight the biotic risks such as the presence of bacteria, viruses and other emerging pathogens that can contaminate food and other animal/vegetal raw material´s products.

f) Traceability of measures

This type of traceability ascertains the individual actions´ result when using a calibration system as standard reference. In order to achieve this, the measures, equipment and tests used, should be calibrated according to national and international standards; ensuring the traceability. Another aspect of the measures´ traceability is related to the characteristics of the measures (dada and calculations) generated throughout the supply chain, and with the intention of meeting the quality requirements.

According to Silva (2004), traceability works as a complement to the quality management and when it´s singly applied it doesn´t reflect safety neither to the product nor to the process. Traceability must be aggregated to other quality control systems, such as the HACCP (Hazard Analysis and Critical Control Point) and the codes of practice, like EureGAP in the case of fruits.

4 Case Study

Usina São José da Estiva S/A – Sugar and Alcohol, or simply Usina Estiva, is located in the municipality of Novo Horizonte, to the northwestern region of São Paulo´s State. It produces sugar, alcohol and electricity. It´s considered a large-sized company with the international quality certification ISO 9001:2008, and it´s in the middle of the process of getting the certification ISO 22000:2005. The industrial process of the company is entirely documented within the information standards of ISO 9001:2008, forming a database of documents describing each individual activity that was held throughout the production process, such as, physical, physic-chemical or biologic processes, maintenance activities, calibration of equipment and corrective actions for the equipment and tools. And all this data can be used for processes consultation.

Figure 3 presents the flowchart of the crystal sugar production process of Usina Estiva.

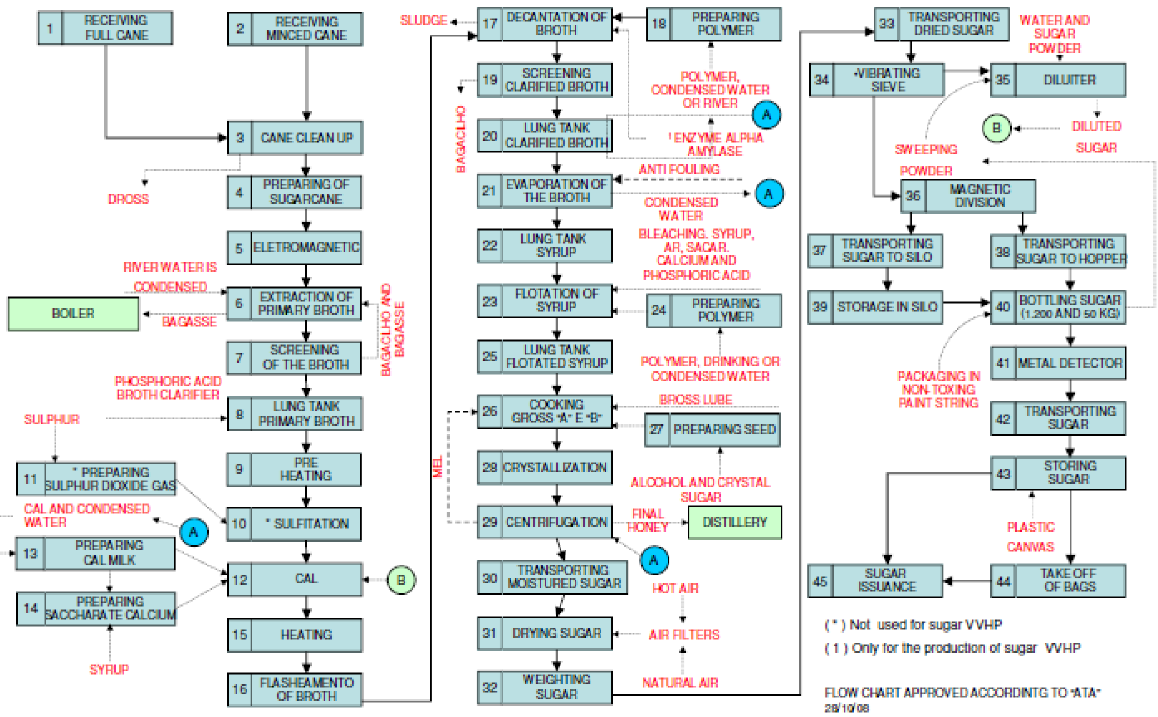

Figure 3: Chartflow of the Crystal sugar production process of Usina Estiva. Source: Usina São José da Estiva S/A, 2010.

In 2003, the Quality Management Supervisor developed a traceability system for Usina Estiva in order to atend the 7.5.3 requisites (Identification and Traceability) of the ISO 9001:2000. On October 2004, Usina Estiva had its Quality Management System by the Bureau Veritas Certification. From 2007 on, a System of Food Safety Management based on the standard ISO 22000:2006 started to be developed at the company and its Traceability System was revised to attend the 7.9 requisite (Traceability System).

In the management system of food safety of Usina Estiva, a multitask team trained in food safety identified potential hazards that can be in the sugar. In order for them not to occur over the acceptable levels, Critical Control Points (CCP) were established, with the help of the HACCP plan, and they must be monitored and the monitoring must be verified to ensure its efficiency. Chart 1 presents the identified hazards and its stages of control.

Chart 1: Summary of the HACCP plan for crystal sugar of Usina Estiva

Stage of Control	Hazards	Monitoring	Inspection
Broth Sulfitation	**Chemical** Sulfite	Dosage of sulfur and flow of the broth.	Assessing the ocurrence of out of specification sulfite in the final product.
Decanting Of the Broth	**Physical** Ferrous metal, nonferrous metal and sand **Chemical** Excesso f Polymer and Phosphoric Acid.	Temperature, pH , flow of the broth; flow of the metering pump of the polymer and phosphoric acid.	Analysis of filling in the worksheets of the FAB-RQ - 031 conformities and internal audit processes.
Evaporation Of the Broth	**Biological** Salmonella and Escherichia Coli	Monitoring the temperature of the broth with the thermometer line PT 100.	Analysis of Salmonella and E. Coli in the final product, analysis of the filling in of the worksheets FAC-RQ-031- Control of the CCPs – Sugar Factory and – Internal Audit of the processes.
Flotation of Syrup	**Physical** *Bagacilho* **Chemical** Excess of Polymer and Phosphoric Acid.	Temperature, pH , flow of the syrup and flow of the metering pump of the polymer and phosphoric acid.	Analysis of the filling in of the worksheets FAC-RQ-031 – Control of the CCPs – Sugar Factory and Internal Audit of the processes.
Sugar Screening	**Physical** Fouling and Nonferrous metal	Integrity of the sieve screen.	Analysis and if necessary repair in the sieve, analysis of the filling in of the worksheets ENS-RQ-017 and internal audit of the processes.
Magnetic Separation	**Physical** Ferrous Metal	Volume of materials in the separators.	Analysis of the filling in of the worksheets ENS-RQ - 007 and internal audit of the processes.

Source: Usina São José da Estiva S/A, 2011

The traceability system of Usina Estiva was developed in the program Microsoft Excel, it´s based on the knowledge of the process and its scope goes from the raw material (sugarcane) to the distribution of the final product, taking into consideration all the inputs and variables of the process. In this system it´s possible to accomplish the traceability of the product, process, inputs and measures of the downstream and upstream.

To demonstrate de capability of this Tracking System in establishing the causes of nonconformities of downstream and upstream, we presented the result of the application of the system in two different moments: one with a chemical contamination in the final product (chart 2) and the other one with the identification of a potential contaminated product when a flaw occurs in the decantation process (chart 3).

Chart 2: Application of the Traceability System (upstream)

Bag Nº 82.301			**DATE/TIME OF BOTTLING** 11/04/2009 06:00		
Stage of process	**Records**	**Information**	**Time Reference**	**Verified Period**	**Result of Verification**
Loading Transport	FAT-RQ-006	Condition of approval, sugar quantity, type of sugar, client, type of package.			☒ Conforming ☐ Nonconforming

Storage	ENS-RQ-011	Lot, bag number, date of production.			☒ Conforming ☐ Nonconforming
Dryer	ENS-RQ-018 FAC-RQ-027 CPI-RQ-004 ENS-RQ-017	Change of filter, Parameters of the process (color, in., moisture, dextran, insoluble starch, turbidity, average opening, coefficient of variation and bottom).	00:30 ± 02:00 11/04/09 5:30	11/04/09 3:30 até 11/04/09 7:30	☒ Conforming ☐ Nonconforming
Centrifugation	FAC-RQ-006 FAC-RQ-018	Stops of the centrifugation, change de filter.	00:30 ±02:00 11/04/09 5:00	11/04/09 3:00 até 11/04/09 7:00	☒ Conforming ☐ Nonconforming
Cooking	FAC-RQ-007 FAC-RQ-021	Duration of cooking and cleaning of the cookers	03:30 ±04:30 11/04/09 1:30	11/03/09 21:00 até 11/04/09 6:00	☒ Conforming ☐ Nonconforming
Syrup flotator	FAC-RQ-022 FAC-RQ-025	Quantity of polymer and phosphoric acid, parameters of process (temperature and pH)	00:30 ±02:00 11/04/09 1:00	11/03/09 23:00 até 11/04/09 3:00	☐ Conforming ☒ Nonconforming

Source: Usina São José da Estiva S/A, 2011

The traceability develop on chart 2 identified that during the reduction of the processed syrup volume (intermediate product) there was no reduction in the applicability of the polymer and acid in the same proportion, which determined the chemical contamination of the product.

Chart 3: Application of Traceability System "downstream"

PLACE OF NONCONFORMITY DECANTING			**DATE/TIME** 07/25/2011 18:00		
Stage of the Process	**Records**	**Information**	**Time Reference**	**Verification Period**	**Result of the Verification**
Decanting	FAC-RQ-022 FAC-RQ-025	Quantity of polymer, quantity of phosphoric acid, specifications, parameters of the process (temperature and pH)	03:00 ±04:00 07/25/11 18:00	07/25/11 14:00 até 07/25/09 22:00	☐ Conforming ☒ Nonconforming
Evaporation	FAC-RQ-002	Cleaning of the evaporators	00:30 ± 02:00 07/25/11 18:30	07/25/11 16:30 até 07/25/11 20:30	☒ Conforming ☐ Nonconforming
Syrup Flotator	FAC-RQ-022 FAC-RQ-025	Quantity of polymer and phosphoric acid, parameters of process (temperature and pH)	00:30 ±02:00 07/25/11 19:00	07/25/11 17:00 até 07/25/11 21:00	☒ Conforming ☐ Nonconforming
Cooking	FAC-RQ-007 FAC-RQ-021	Duration of cooking and cleaning of the cookers	03:30 ±04:30 07/25/11 22:30	07/25/11 18:00 até 07/26/11 3:00	☒ Conforming ☐ Nonconforming
Centrifugati on	FAC-RQ-006 FAC-RQ-018	Stops of the centrifugation, change of filter	00:30 ±02:00 07/25/11 23:00	07/25/11 21:00 até 07/26/11 1:00	☒ Conforming ☐ Nonconforming
Dryer	ENS-RQ-018 FAC-RQ-027 CPI-RQ-004	Change of filters, Parameters of the process (color, in.,	00:30 ± 02:00 07/25/11 23:30	07/25/11 21:30 até 07/26/11 1:30	☒ Conforming ☐ Nonconforming

	ENS-RQ-017	moisture, dextran, insoluble starch, turbidity, average opening, coefficient of variation and bottom).			
Storage	ENS-RQ-011	Lot, bag number, date of production.	Lots E2507112200 e E2607111000 – bags de nº 11030475 a nº 11030626 – Warehouse 4		☒ Conforming ☐ Nonconforming

Source: Usina São José da Estiva S/A, 2011

The traceability developed on chart 3 identified the produced lot and its location (warehouse 4). The bags from the lot were segregated and identified as (potentially unsafe product) until a corrective action could be taken.

5 Conclusion

During the last decade not only the productive process and technology developed but also the commercial demand and costumes requirements increased. Nowadays it is not enough to be productive companies, they also have to be efficient in all marketing aspects and dimensions. And when it comes to companies that produce or hand food, these dimensions are more and more linked to the food safety.

On this context it gets clearer and clearer, be it for legal demand or market demand, that the tracking availability has a major role when it comes to ensuring food safety. This traceability must be agile, accurate and trustworthy in a way that it will transmit confidence to consumers.

The ISO 22005:2007 – Food Chain Traceability, establishes the general principles and basic requirements for the design of tracking system, but it doesn´t present any methodology of development. As a contribution of this paper, we will describe below the methodology used on the development of the tracking system of Usina Estiva. We would like to point out that the process used here is continuous therefore it is necessary to work with periods of time to establish bundles of intermediate products.

a) Determine the scop of the tracking system;
b) Describe the chart flow within this defined comprisement;

c) Establish the steps of the process that allow you to determine the time spam that the intermediate product remains kept in the process and/or between processes;
d) Establish the average time of retention in those steps of the process;
e) Establish safe deadlines for these periods of time;
f) Establish the sequence and the relationship of these steps according to the chart flow;
g) Establish bundles of finished products and identify them;
h) Determine the information required for the safety of the food in each step (waste material, activities, parameters of process, etc) and keep reports available;
i) Make the tracking so that you can identify possible flaws.

The traceability system of Usina Estiva is integral and fundamental part of the System of Quality Management and System of Food Safety Management, so it is up-to-dated and validated periodically through making situations even though there are flaws that should be analyzed and solved as occurs at the sugar bulk shipment. The sugar silo (where sugar bulk is stored) is fed and discharged simultaneously what causes the loss of identification of the sugar frequently.

This way we can conclude that the tracking systems should be developed, implemented and assessed continuously and improvements should be proposed in order to accomplish the requirements of food safety, to ensure costumers satisfaction and the continuity of the company.

References

EAN BRASIL. Diretrizes de Rastreabilidade para Produtos Hortícolas. <http://www.eanbrasil.org.br>. (08 ago.2003)

GOLAN; E.,et. al. Traceability in the U.S. food supply: economic theory and industry studies. United States. Dept. of Agriculture. Economic Research Service. in Agricultural Economic Report, n. 830, 2003.

GRUNERT, K. G.. Current issues in the analysis of consumer food choice. 71 st EAAE Seminar- The Food Consumer in the early 21 st Century: 2001.

JURAN, J.M.; GRYNA JR, F.M. Controle de qualidade. Handbook. São Paulo: Makron Books, v.3. 1993.

LEONELLI, F. C. V. Identificação e rastreabilidade: proposição de um modelo para o gerenciamento de grãos. Tese (Doutorado) -- Universidade Federal de São Carlos – UFSCAR. São Carlos, 2007.

LIMA, M. A. C. Segurança de alimentos. Brasília: Agência de Informação EMBRAPA.

MACHADO, R.T.M. Rastreabilidade, tecnologia de informação e coordenação de sistemas agroindustriais. São Paulo, 2000. 239p. Tese (Doutorado) – Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo.

MACHADO, R. T. M. Sinais de qualidade e rastreabilidade de alimentos: uma visão sistêmica. Organ. rurais agroind., Lavras, v. 7, n. 2, p. 227-237, 2005.

MEUWISSEN, M. P. M. at al. Traceability and Certification in Meat Supply Chains. Journal of Agribusiness 21(2):167-181, 2003.

MOE, T. Perspectives on traceability in food manufacture. Food Science & Technology v.9, 1998, p.211-214. Elsevier, U.K, 1998.

PALLET, D. (2003) – Considerações sobre a Rastreabilidade dos Alimentos. <www.pallet@cendotec.org.br>. (16 mar.2004).

SARIG, Y. Traceability of Food Products. Agricultural Engineering International: the CIGR Journal of Scientific Research and Development. Invited Overview Paper. Bologna, v. V, dec. 2003. Presented at the Club of Bologna meeting, Italy November 16, 2003.

SILVA, R. A. S. da. A implantação de um plano APPCC em um abatedouro de aves : Produto: frango inteiro desossado congelado. 2004. 48 f. Monografia (Especialização em Qualidade em Alimentos)-Universidade de Brasília, Brasília, 2004.

SILVEIRA, J. V. F.; RESENDE, L. M. M.; PILATTI, L. A.. Rastreabilidade: uma Exigência da Cadeia Agroindustrial para Produtos Especiais. Revista Produção On Line. Universidade Federal de Santa Catarina Florianópolis – SC. ISSN 1676 - 1901 / Vol. 6/ Num. 1/ Abril de 2006.

SOUSA, E.L.L. Preservação da identidade de grãos e a coordenação dos sistemas agroindustriais. Piracicaba, 2001. 177p. Tese (Doutorado em Economia) – Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo. Piracicaba.

SOUZA, V. J.; CAMPOS, R. de. Mapeamento de processo de produção de açúcar visando a rastreabilidade do produto. XXVIII Encontro Nacional de Engenharia de Produção. Rio de Janeiro, RJ, Brasil, 13 a 16 de outubro de 2008.

OPARA, L.U. (2003). Traceability in agriculture and food supply chain: a review of basic concepts, technological implications, and future prospects. Food, Agriculture & Environment Vol.1(1): 101-106. WFL Publisher.

UNICA – União das Indústrias de Cana-de-Açúcar. Dados disponíveis em <www.portalunica.com.br>, acessado em 25 mar. 2008.

VERGARA, S. C. Projetos e Relatórios de Pesquisa em Administração. 9 ed. São Paulo: Atlas, 2007

VINHOLIS, M. de M.B. e AZEVEDO, P. F. de Efeitos da Rastreabilidade no Sistema Agroindustrial da Carne Bovina Brasileira. Grupo de Estudos e Pesquisas em Trabalho, Agroindústria e Políticas Públicas: Departamento de Engenharia de Produção – UFSCar – SP, 2000.

VINHOLIS, M. M. B.; AZEVEDO, P. F. Segurança do alimento e rastreabilidade: o caso BSE. Revista de Administração de Empresas. São Paulo, v. 1, n. 2, jul./dez. 2002. Seção: gestão de operações.

YIN, R. K. Estudo de Caso – Planejamento e Métodos. Porto Alegre – RS: Editora Bookman. 2003. 212 p.

YUGUE, R. A necessidade de sistemas de rastreabilidade. 01 julho 2003 Disponível em <http://www.eanbrasil.org.br/servlet/ >. Acesso em 03/07/2003.

ZANATTA, T. S. da C.; HENDGES T. L. Implantação da Rastreabildiade na Multiplicação de Sementes de Soja - Revista Científica da Faculdade de Balsas, Ano I, número 1, 2010.