TRACEABILITY OF FOOD PRODUCTS AND PHARMACEUTICAL PRODUCTS IN RELATION TO CHEMICAL INVESTIGATION

Mirela Ahmadi-Vincu[1,6], Gabriela Garban[2,6], Florin Muselin[3,6], Robert Ujhelyi[4,6], Zeno Gârban[5,6]

[1]Department of Biochemistry, Faculty of Veterinary Medicine, University of Agricultural Sciences and Veterinary Medicine of Banat "King Michael I of Romania", Calea Aradului No. 119, Timişoara, Romania; [2]Laboratory of Environment and Nutrition, National Institute of Public Health-Branch Timişoara, Romania; [3]Department of Toxicology, Faculty of Veterinary Medicine, University of Agricultural Sciences and Veterinary Medicine of Banat "King Michael I of Romania" Timişoara, Romania; [4]Medical Department, S.C. CaliVita International, Timişoara, Romania; [5]Department of Biochemistry and Molecular Biology (former), Faculty of Food Products Technology, University of Agricultural Sciences and Veterinary Medicine of Banat "King Michael I of Romania" Timişoara; [6]Working Group for Xenobiochemistry, Romanian Academy-Branch Timişoara, Bd. M. Viteazu No. 24, Romania
e-mail: zeno.garban@yahoo.com; mirelaahmadi@gmail.com

Abstract

Approaching issues related to the traceability of food and pharmaceutical products at the 26th International Symposium on Analytical and Environmental Problems, would like to point out the fact that the analytical chemistry investigations and their applications target both natural and processed products in the food and pharmaceutical industry (some raw materials being taken from the environment).

In this context, the paper presents summary data on the traceability systems (integrated and differentiated). Thius, in order to highlight the scientific, technical and economic importance of traceability some data about the identification tools are summarized.

Key words: traceability systems, identification tools

Conceptual aspects

In the domain of food and pharmaceutical products, data on the origin of the raw material, its processing, distribution and location after delivery are of main interest.

The implementation of traceability systems primarily targets food products (e.g. raw materials and processed foods), pharmaceuticals (e.g. drugs obtained by extraction or synthesis) and agrobiological products (e.g. plant growth bioregulators, especially synthetic compounds) - see Pouliot şi Sumner (2010); Cuntroneo et al. (2014); Gârban (2020).

Traceability or product tracing is defined by the Codex Alimentarius Commission as "the ability to follow the movement of a food through specified stage(s) of production, processing and distribution" (http://www.fao.org/fao-who-codexalimentarius).

Globally, traceability issues are specified by the Codex Alimentarius and are "extrapolated" through the use of Information and Communication Technology (ICT). In this way it was possible to establish a Global Traceability Standard (GRS).

It is important to know that xenobiotics (physical, chemical, biological agents) can contribute to the sanitation of the environment with harmful effects in time and space (Walker et al., 1996; Gârban 2020).

The problem of food and pharmaceutical products traceability - in relation to analytical chemistry and environmental issues - is also of interest to nutrivigilence and pharmacovigilance (Ahmadi et al., 2007; Klein and Stark, 2018). Therefore, it is important to know the identifying tools for the products.

Traceability systems

Traceability can be approached in two distinct ways: "in an integrated system" and "in a differentiated system". The specifics of these systems will be briefly discussed below.

Traceability sometimes also involves physico-chemical methods (the called so-called instrumental methods). An example of this is a study undertaken by Zhou et al. (2007) which followed the geographical traceability of samples of propolis from various Chinese provinces. It is known that propolis is used to obtain extracts of nutritional and pharmaceutical interest. The HPLC method and the HPLC-UV methodological tandem were used for this purpose. Chromatographically, rutin, quercetin, kamferol, apigenin, etc. were identified.

1. Traceability in an integrated system

This system involves tracking a specific product in the chain (raw material): raw material-transport-processing-storage-distribution-marketing-consumer (fig. 1).

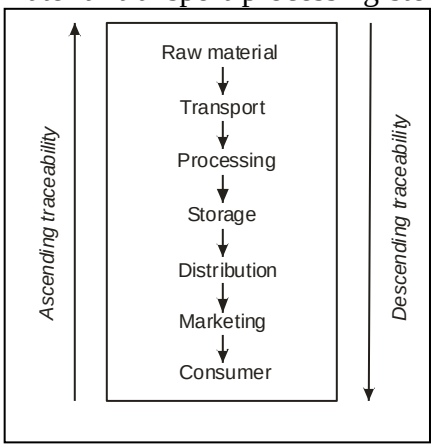

Figure 1. Integrated traceability system

In the integrated traceability system, for product tracking, one can act in two directions (reverse directions) depending of analysis. These are represented by:

□) *Descending (forward) traceability*. It consists of "tracking ahead" and ensures the possibility of locating a product taking into account specific criteria - regardless of where it is in the distribution chain.

□) *Ascending (backward) traceability*. It involves "tracking back" - a circumstance in which one can proceed to identify the origin and characteristics of a product taking into account certain criteria established for distribution points.

2. Traceability in a differentiated system

This system envisages more limited areas pursuing logistics management within the food chain. Within this system, internal traceability and external traceability are distinguished

□) *Internal traceability*. In the case of this type of traceability, a sum of information is considered that interests a certain enterprise / company in the evolution of obtaining the product / food products.

□) *External traceability*. It considers the pursuit of a product along a segment of the food chain, which starts from the finished product obtained by the processor (enterprise / company) to the consumer.

Overall, it can be stated that traceability systems (integrated and differentiated) are of interest to raw material producers, processors, distributors, consumers, but also to the executive power in the state. In this way, coherent measures of socio-economic and medical interest in relation to human nutrition can be ensured.

Identification tools

In order to find out food traceability data different identification tools can be used. A brief description of those tools is of theoretical and applied interest.

A. Barcodes. Encodes information based on numbers represented by a sequence of black and white bars of various sizes. Bar code decryption is done with a scanner. In practice, conditioned by the importance of the marketed product, 8 - 14 digit codes are used for identification (signaling the country, the manufacturer, the product, other details).

B. Radio frequency based benchmarks. In case of *Radio Frequency Identification Devices* (RFID) food data are stored in "electronic circuits" or in "microchips" embedded in plastic material, constituting the so-called "electronic label". For identification there are used various devices operating at radio frequencies ranging between 100 kHz - 2 GHz. These "labels" allow remote data reading.

C. Biological and biochemical tests. The biological and biochemical tests used for identification draw attention to the performance of histology, biochemistry and molecular biology. Although accurate, the application of these methods is limited, due to high costs. Some are mentioned below.

a) Identification of the retinal image. Is based on the recording, with special digital cameras, of the "retinal vascular aspect". This is an attribute of individuality (in this case animals), which is maintained throughout life. It can be applied to live animals transported for slaughter (elsewhere in the world).

b) DNA fingerprint identification. It is based on analyzes specific to molecular biology applied in genetics. In the case of meat and meat products, for example, analyzes based on "DNA fingerprints" can be compared with data on animals from slaughtered lots.There is a great ability to discriminate methods based on molecular biology.

*D. Biodegradable markings.*They are also known as "edible markings" because they are placed directly on the food. They are invisible and is made of an edible substance, e.g. cellulose derivatives. The compound used for labeling is mixed with a certain food ingredient (usually additives). The size of such markings is of the order of 200 μm^2 readable area for a bar code.

E. Markings based on geospatial technology. These include the *Geographic Information System* (GIS) and the *Global Positioning System* (GPS). The latter is a satellite-based radio-positioning system - which contains information and the GPS receiver indicates the location in the field. Marks that use geospatial technology may include the "Quick Response Code", commonly known as the QR Code.Usually, the QR code is a means of storing information in a visual label, which can be read by a device (even a smartphone).

Concluding remarks

1. Traceability systems are of interest to food and pharmaceutical products because they ensure consumer/patient protection by quickly identifying the sources of contamination by government institutions, manufacturers and sellers – throughout the production, processing and distribution chain - and withdrawing the affected product from marketing.

2. In many stages of the entire chain which starts with the raw material, products processing, distribution and saling to consumer (food / medicines) chemical investigations are used.

3. All the identifying tools used in case of food and pharmaceuticl products traceability are based on chemical, physical and biological methods, the ultimate goal being to ensure a fast removal of an affected product from the market for the consumer benefit.

References

[1] Ahmadi Mirela, Avacovici Adina-Elena, Precob V., Sarafolean S., Gârban Z. - *Laboratory handbook, Vol. I. Bioconstituents* (in romanian), Editura Eurobit, Timişoara, 2007.
[2]Cutroneo M. Paola, Isgrň Valentina, Russo Alessandra, Ientile Valentina, Sottosanti Laura, Pimpinella G., Conforti Anita, Moretti U., Caputi P.A., Trifirň G. - Safety Profile of Biological Medicines as Compared with Non-Biologicals: An Analysis of the Italian Spontaneous Reporting System Database, *Drug Safety*, 2014, 37, 961-970.
[3] Gârban Z., Gârban Gabriela – *Human nutrition, Vol.I. Fundamental problems* (in romanian), 3rd edition , Editura orizonturi Universitare, Timişoara, 2003
[4] Gârban Z. - *Quo vadis food xenobiochemistry*, 3rd edition, Editura 3rd edition, Publishing House of the Romanian Academy, Bucharest, 2018 (www.zeno-garban.eu)
[5] Gârban Z. – *Biologically active substances of food, pharmaceutic and agrobiologic interest* (in romanian), Editura ArtPress, Timişoara, 2020
[6] Klein K., Stolk P. - Challenges and Opportunities for the Traceability of (Biological) Medicinal Products, *Drug Safety*, 2018, 41, 911-918.
[7] Pouliot S., Sumner A.D. – *Traceability, Product Recalls, Industry Reputation and Food Safety*, Agricultural Issues Center, University of California, Davis, 2010.
[8] Walker C.H., Hopkin S.P., Sibly R.M., Peakall D.B. (Eds) - in *Principles of Ecotoxicology*, Taylor and Francis, London, 1996.
[9] Zhou J., Li Y., Zhao J., Xue X., Wu L., Chen F. - Geographical traceability of propolis by high-performance liquid-chromatography fingerprints, *Food Chemistry*, 2007, 108(2), 749-759.
[10] *** http://www.fao.org/fao-who-codexalimentarius - accessed August 2020