THE IDENTIFICATION AND EVALUATION OF SOME TOXIC COMPOUNDS IN DRINKING WATER

Filip Vladimir EDU
Angela MĂRCULESCU[1]

ABSTRACT:

THIS PAPER AIMS TO PRESENT METHODS FOR THE IDENTIFICATION OF SOME TOXIC COMPOUNDS (PESTICIDES AND NITRATES) FROM THE DRINKING WATER AND THEIR IMPACT UPON THE CONSUMER'S STATE OF HEALTH. THE POLLUTION OF THE ENVIRONMENT AND THE EXCESSIVE FERTILIZATION LED TO THE PRESENCE OF HIGH LEVELS OF SOME POLLUTANTS LIKE PESTICIDES AND NITRATES IN THE DRINKING WATER AS A RAW MATERIAL IN THE FOOD INDUSTRY. IN THE ACTUAL GLOBAL CONTEXT, THIS SUBJECT IS VERY IMPORTANT AND SHOULD BE AN OVERRIDING PRIORITY IN ENSURING THE CONCEPT OF FOOD SAFETY.

KEY WORDS: DRINKING WATER, NITRATES, PESTICIDES, TOXIC.

INTRODUCTION

The drinking water is the water designated for human consumption. Drinking water can be represented by any type of water in natural state or after some special treatments, deriving from the public distribution chain, from water tanks, that is distributed in bottles or other recipients[7].

Also, drinking water is represented by all types of water used as a main source in food industry, for the fabrication, the processing, preservation or commercialization of products or substances designated for public consumption[7].

The problem of environmental pollution is becoming more and more serious nowadays[2].

[1] PhD Student and Prof. PhD, *Transilvania* University of Braşov, Faculty of Food and Tourism, Department of Food and Tourism Management and Engineering, e-mail: vladimir_edu@yahoo.com.

[2] Ciurea, A. V., Edu, F. V., *Probleme de nocivitate în alimentele uzuale* , Galaxia Gutenberg, Târgu Lăpuş, 2011.

[7] The Romanian Parliament, *Legea 458/ 2002 privind calitatea apei potabile.*

The substances from agriculture that are potentially noxious (pesticides and nitrates) arrive in the water as a raw material and in food, in quantities that are above the admitted levels, that are levels that would not normally produce adverse effects upon the consumer's state of health[1].

The human organism has the capacity of adapting to the action of some toxic substances that are in small doses and that do not trigger cumulative effects[1].

The great majority of toxic substances have cumulative effects and this can lead to negative effects in time. The action of these compounds can lead to cancer, mutations, genetic effects and specific toxic effects[1].

In the last few years, the pollution of the surface and underground waters with pesticides constituted an important problem, especially in agricultural areas[1].

In some cases, the contamination of the waters persists for decades after the use of the specified compounds is stopped[1].

Many food samples are analyzed annually, for the determination of the correlation with the general allowances established for agricultural products. The residues of pesticides were identified in half of these samples[1].

Nitrates appear naturally in the water, because they are part of the nitrogen cycle[1].

Nitrates are not cancerous as such, but they are transformed inside the human body in nitrites. Nitrites react with tertiary amines, resulting in the apparition of nitrous-amines that are cancerous compounds[1].

Nitrates are found in food in large amounts, especially because of the excessive fertilization. In some areas, drinking water contains large amounts of nitrates[1].

The relation between agriculture, alimentation and health is becoming more and more evident, because the diseases of the modern civilization are put upon an off-balanced diet and as a reason of excessive use of chemical substances[1].

OBJECTIVES

The general objective of this paper is consumer information[2].

The specific objectives of this paper constituted in the presentation of some control methods for toxic substances like pesticides and nitrates from the drinking water, the analysis of some important studies made by specialized institutions in this field, the

correlation of this information with reference tables like *The codex of the phytosanitary products*[2].

All of this data was collected with the aim of obtaining as much information in the problem of the presence of some potentially noxious compounds in the drinking water as a raw material in food industry[2].

MATERIALS AND METHODS

This study aims to present some data from the specialized literature regarding the implications of the presence of some noxious compounds in the drinking water and in water as a raw material for the fabrication of food[2].

The experimental part has the role of correlating the scientific information about noxious compounds with some methods for their monitoring and control in the drinking water[2].

The research had as specific objectives the following:

1. The analysis of the gas-chromatographic method for the identification of organoclorine pesticides from the drinking water;

2. The spectra-photometric analysis of the nitrates from some samples of drinking water;

3. Statistical graphics elaborated by specialized institutions, like The Institute for Public Health in Bucharest;

4. Official information: studies conducted by specialized organisms in the area of consumer information, like *The study of some quality parameters of the mineral waters from the Romanian market*;

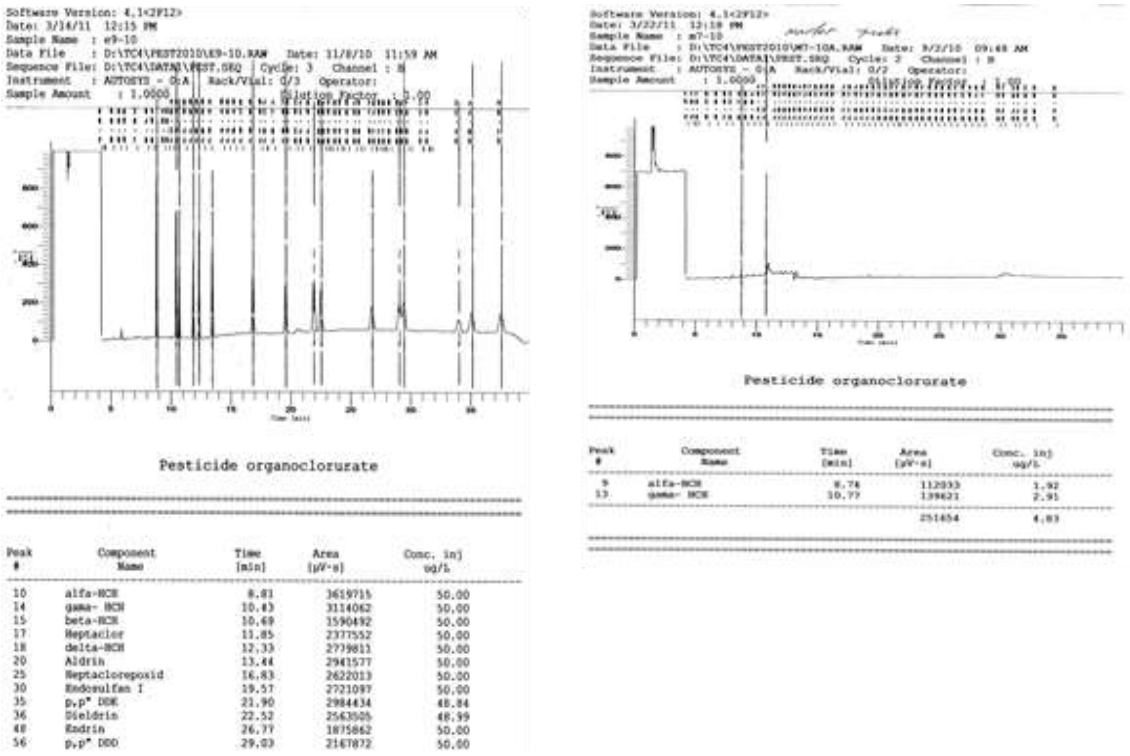
5. Reference tables and data: *The codex of the phytosanitary products* [2].

RESULTS AND DISCUSSION

Gas-chromatography is a method by which the specific components of a mixture in gaseous state are separated, when the samples are passed through a liquid or solid stationary phase. This method is used for the identification of about 60 % of the organic compounds[3].

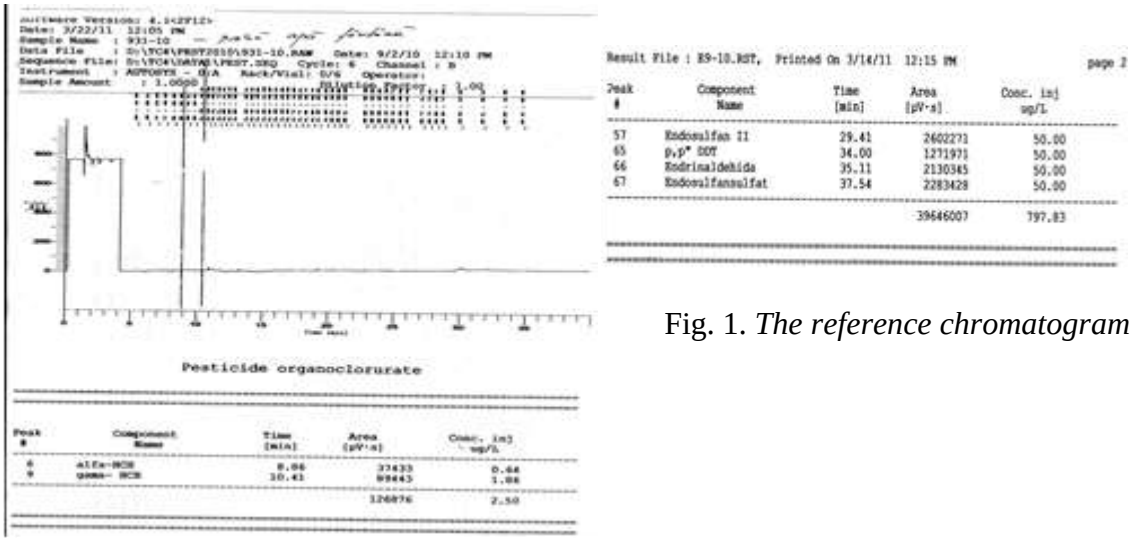
The protocol of work for the gas-chromatographic method consists of: extraction and separation, the concentration of the extract, chromatography in gaseous state, purification and separation and the determination of the witness sample[5].

The chromatograms for the identification of organoclorine pesticides (fig. 1, fig. 2, fig. 3) in a number of 20 samples were studied. These results of the study offer a very good model for understanding the details of the gas-chromatographic method of analysis.[3]



Peak #	Component Name	Time [min]	Area [pV·s]	Conc. inj ug/L
10	alfa-HCH	8.81	3619715	50.00
14	gama- HCH	10.43	3114062	50.00
15	beta-HCH	10.69	1590492	50.00
17	Heptaclor	11.85	2377552	50.00
18	delta-HCH	12.33	2779811	50.00
20	Aldrin	13.44	2941577	50.00
25	Heptaclorepoxid	16.83	2622013	50.00
30	Endosulfan I	19.57	2721097	50.00
35	p,p' DDE	21.90	2984434	48.84
36	Dieldrin	22.52	2563505	48.99
48	Endrin	26.77	1875862	50.00
56	p,p' DDD	29.03	2167872	50.00

Fig. 2. The reference of reactive chromatogram



Peak #	Component Name	Time [min]	Area [pV·s]	Conc. inj ug/L
57	Endosulfan II	29.41	2602271	50.00
65	p,p' DDT	34.00	1271971	50.00
66	Endrinaldehida	35.11	2130385	50.00
67	Endosulfansulfat	37.54	2283428	50.00
			39646007	797.83

Fig. 1. *The reference chromatogram*

[3]. Edu F. V., *Studii privind prezenţa unor substanţe nocive în apa potabilă*, *Transilvania* University of Brasov, Brasov, Romania, 2011.

3. Papuc, C., *Chimie analitică, Printech,* Bucuresti, 1999.

5. The Public Health Direction from Brasov, *Gaz – cromatograful Autosystem XL – Prospect tehnic al aparatului,* 2011.

Fig. 3. The chromatogram of a fountain water sample

The analyses conducted showed that organoclorine pesticides are present in very small amounts in the drinking water.

The codex of the phytosanitary products is a document that has a very high scientific value, because it inventories the commercial products used in agriculture for the prophylactic treatment of crops, and also their active compounds[6].[4]

The paper contains two main chapters: the index of phytosanitary products and the index of active compounds[6].

From this paper, the complexity of the chemical substances used for the prophylactic treatment of the plants can be seen[2].

This can have negative connotations upon the consumer's state of health, because the residues of these specific compounds may be found in different proportions in the agricultural and food product[2].

Table 5 An extract from The codex of the phytosanitary products

Commercial product	**Producer**	**Licence**
Acedin Super 40	Alchimex Romania	1973/ 2001
Betanal Expert	Bayer Germany	2069/ 2001
Carbiguard 500 SC	Gharda Chemical Ltd. India	1894/ 1999
Roundup	Monsanto US	480/ 1996
Superwax	Stockton Chemical US	2167/ 2002

Each year, in Romania, hundreds of children suffer or even die because water from uncontrolled sources, as for example some fountains from rural areas is introduced in their alimentation[8].

[6.] The Minsitry of Agriculture from Romania, *Codexul produselor de uz fitosanitar omologate pentru a fi ultilizate în România,* 2004.

The Institute of Public Health from Romania performed for the first time in 1988, a national study regarding the nitrate content of fountain water from different areas. The results indicated as areas with a risk of nitrate contamination the South and North – East parts of Romania[8].

Nitrates (NO_3) appear naturally in water, being part of the nitrogen cycle. Also, nitrates may derive from the unintentional introduction in the water of large quantities of chemical fertilizers that contain nitrogen or as a cause of the infiltration of some residual waters that are rich in organic substances, as a consequence of ammonia (NH_3) oxidation. Nitrates are completely and rapidly absorbed in the intestine. The most serious disease caused by the pollution of the water with nitrates is the apparition of met-hemoglobinemy, also known as the *blue baby syndrome*[8].

In drinking water, the maximum admitted concentrations of nitrates were established in correlation with their capacity of inducing met-hemoglobinemy. The apparition of met-hemoglobin was determined only in the situation of the consumption of water with high amounts of nitrates, the maximum limit established by the WHO (World's Health Organization) being of 50 mg/l[8].

Nitrates as such are not cancerous, but the fact that they may be transformed inside the human organism, resulting in the formation of nitrosamines, that are potentially cancerous substances is admitted[1].

Nitrates may also produce hypertension, malfunctions of the circulatory system, even congenital modifications or spontaneous abortions. For example, the nitrates in the drinking water were associated with the risk of gastric cancer in Columbia or England and the exposure at fertilizers that contain nitrates was correlated with the mortality caused by gastric cancer in Chile[8].

There were 5 (five) samples of drinking water that were subjected to analysis regarding the nitrate content:

- Bottled water (sample 1);
- Bottled water (sample 2);
- Hydrophore water (sample 3);
- Spring water (sample 4);
- Tap water (sample 5)[2].

[8] Hypocrite Magazine, *Ediţie Specială Sănătate Publică,* 2011.

The method used for the analysis was the spectra-photometry of absorbance (Tab. 6).

Table 6 – *The nitrate content of different water samples*

No.	Sample	Result (mg/l)
1.	Bottled water	4,01
2.	Bottled water	29,36
3.	Hydrophore water	0,75
4.	Spring water	5,81
5.	Tap water	5,51

According to the Romanian law number 458 from 2002 on drinking water, the maximum admitted limit for nitrates is 50 mg/l. Having taken this fact into account, all of the samples complied with the law[2].

In the case of sample 2, the identified concentration may be a potential health risk for the consumer, even though it is situated above the maximum admitted level[2].

For sample 3, we can see a very small concentration of nitrates. The sample was taken from the phreatic water, were there is very small pollution with nitrogen[2].

Samples 1, 4 and 5 indicated an average level of 5 mg/l. This value doesn't set any potential problems for the consumer's state of health[2].

Some results of research in the area of water quality, like The study of some quality parameters of the mineral waters from the Romanian market revealed the fact that at the chapter of Toxicity, the great part of the tested water samples from the market, complied with the standard[4].

CONCLUSIONS

The studies and analyses in this paper show that the pollution of the environment is a serious problem nowadays. This has a direct influence upon the consumer's state of health.

The strong relation between environment, food and health is clearly established, but in the context of environmental pollution, this is an acute problem.

Drinking water as a raw material in food industry is very important for the obtaining of some safe food products. Primarily, drinking water should be strictly controlled, mainly regarding the presence and quantification of some toxic or undesirable compounds, as in the aspect of its properties or some parameters that confer the optimal chemical composition.

The national reserves of water are a problem of national security, that’s why public institutions advised in the field of food control should develop their strategies and methods for the insurance of both the safety and the quality of drinking water.

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