THE ACTUAL DIMENSIONS OF THE WATER POLLUTION WITH NITRATES IN RURAL AREA OF BACAU COUNTY

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Abstract: *Nitrates determination in the drinking water represent the first stage in the risk assessment for health. These evaluations of the quality of the water are a permanent concerning for specialists and the present paper refers to two distinct stages: until 1997, as a result of current actions in teritory and after this date, as investigations of water incriminated to produce acute intoxications in infants. Retrospective data informations from 1983-1997 reveal decreasing frequences of water samples with normal concentration of nitrates and helped to draw a map of areas with high risk from this point of view. More recently investigations show improper situations of quantitative water supplies, improper conditions of emplacement, protection or maintain the fountains and also chemical contamination with nitrates in over 86% of cases. Very often the same rural areas have a high risk. The paper recommends some actions as descriptive and analytic epidemiological studies concerning the effects of chronic use of contaminated water by vulnerable segments of population.*

Cuvinte cheie: *nitraţi în apă, zone rurale cu risc*

Rezumat: *Determinările de nitraţi în apa potabilă reprezintă prima etapă în evaluarea riscului pentru sănătate reprezentat de aceştia. Aceste evaluări ale calităţii apei reprezintă preocupare cvasipermanentă de specialitate şi lucrarea se referă la 2 etape distincte: până în 1997, ca rezultat al unor acţiuni curente sau de anvergură în teritoriu şi după această dată, ca expertize ale apei incriminate în producerea intoxicaţiilor acute la sugari. În retrospectiva datelor din 1983-1997, menţionăm frecvenţe în scădere ale probelor cu concentraţii normale de nitraţi şi delimitarea unor zone cu risc crescut din acest punct de vedere. Investigări mai recente arată situaţii nefavorabile ale aprovizionării cu apă d.p.d.v. cantitativ, condiţii neigienice de amplasare şi intreţinere a fântânilor şi, fiind vorba de apa încriminată în producerea intoxicaţiei la sugar, contaminare cu nitraţi în peste 86 % din cazuri. Se confirmă adesea aceleaşi zone rurale cu risc crescut. În lucrare se propun câteva măsuri între care realizarea unor studii epidemiologice descriptive şi analitice privind efectele consumului îndelungat a apei contaminate de către segmente populaţionale vulnerabile.*

INTRODUCTION

In the gradual process of environmental epidemiology, risk assessment is important from at least two reasons: firstly, it is used in the process of risk management for establishing the priorities and taking important decisions of public health politics and secondly, it helps to formulate messages for public in order to communicate the risks for living in an unhealthy environment (1,2).

In the risk assessment process, ***exposure evaluation*** it is done through the monitorization networks which measure ***the concentration*** of contaminant in environmental elements. Even if critical parameter is ***exposure*** and not ***concentration***, simple determination of pollutants in environmental elements is not relevant without existing the proof of unhealthy impact on health population. Quantitative determination of contaminants in environmental elements is a compulsory step in any epidemiological study (3).

The present paper intents to present a summary of monitorization actions on the quality of drinking water provided through the local systems (fountains) in the rural area, mentioning also some approaches differences imposed along years by the legislation.

MATERIAL AND METHOD

For a long time, surveillance/monitorization the quality of drinking water in the rural area was the current activity of the specialized laboratories from The County District Health Authorities.

In the present, monitorization of water quality is not explicitly mentioned in the objectives of The National Program of Health in relationship with the Environment, who regulate the preventive activity of specialized medical services. These investigations are done mostly as specialty examinations in order to diagnose in some rural areas, the acute methemoglobinemy in infants.

In the rural area, the monitorization activity of water quality, from the point of view of nitrates concentrations, vary in different periods.

1) In the previous period of time, until 1993-1997, water monitorization was the current activity of specialized laboratories from District Health Authorities (4)
2) . For the last 13-15 years, monitorization of water quality consists in distinct examinations of water samples, in the areas where acute methemoglobinemy in infants appeared.

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The data collected from the specialized laboratories of chemical analyses are processed using the following indicators:

a) the number and the proportion of samples with concentration of nitrates above Maximal Admission Concentration (MAC);
b) the distribution of analyzed samples for the quantity of nitrates in water;
c) territorial distribution of cases with values above MAC for nitrates.

These results make possible to draw the map of areas with a high risk for acute methemoglobinemy in infants (5) but also for the late, chronic effects at children using for long time contaminated water with nitrates (6).

RESULTS AND DISCUSSIONS

The first period studied in the present paper refer to the period ,between the years 1983-1997, when water quality monitorization was a current activity in District Health Authorities. In the period 1983-1988, in Bacau county were realized three important monitorization actions, as follow (4):

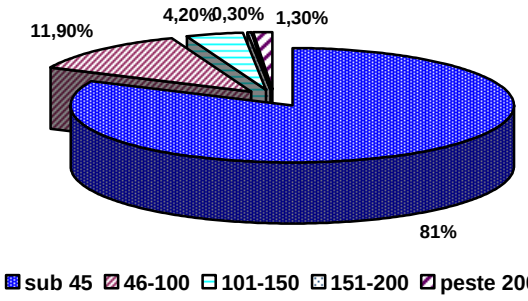
- in 1983, 311 samples were analyzed from 86 localities and 81% of them have had normal quantities of nitrates; in some samples from the rest of analyzed samples,the values were above 250 mg/liter;
- in march 1988, on 112 samples from 22 localities, the proportion of good quality water with normal nitrates concentration was 53.6%;

a. in june 1988, on the same number of samples from the same localities, 57% of samples were normal (tab 1, fig 1)

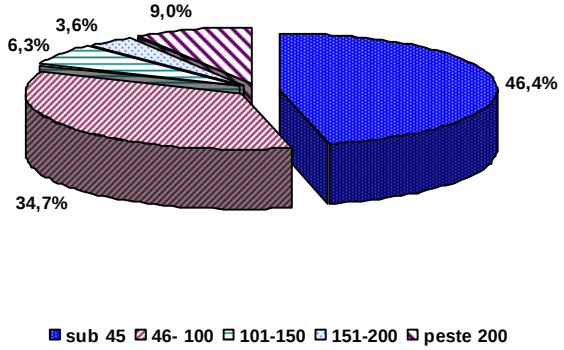
In the period 1985-1993, in some localities : Luizi Calugara, Faraoani, Valea Seaca, N. Balcescu, from 146 water samples, 40% had improper values of nitrates before 300 mg/l (Valea Seaca, 1986);

Figure no. 1. The distribution of the analyzed water samples in three stages in Bacau county after the concentration (mg/l) of nitrates (p 100 from the total analyzed samples)

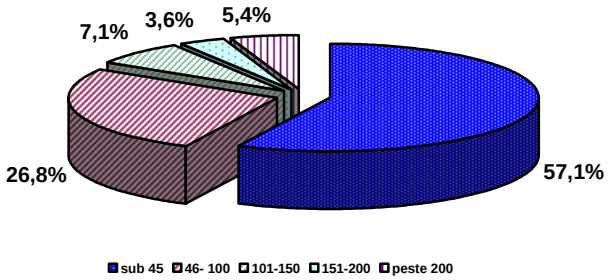
1983 n = 311



March 1988 n= 112



June 1988 n=112

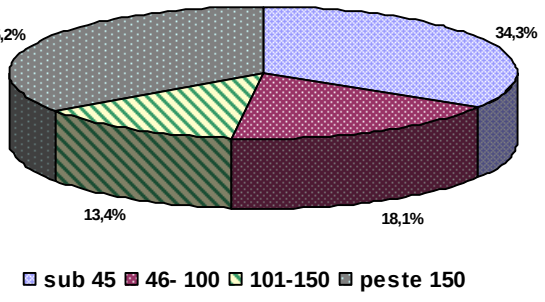


- according with the number of cases of methemoglobinemy registered in infants in previous period, the localities Faraoani and Luizi Calugara were classified in the category with the highest risk and the localities Cleja, N. Balcescu, Sarata, Valea Seaca, Horgesti, Tamasi, Racaciuni were considered with lower risk.

Between the years 1996-1997, in these localities were analyzed 131 and respectively 145 water samples. The proportion of samples with normal concentration doesn't differ between the two categories of localities, being around 1/3 from the total. In the first risk zone existed over 1/3 of the samples with the nitrates values above 150 mg/l, while in the second risk zone, this percent was almost of three time smaller (fig 2).

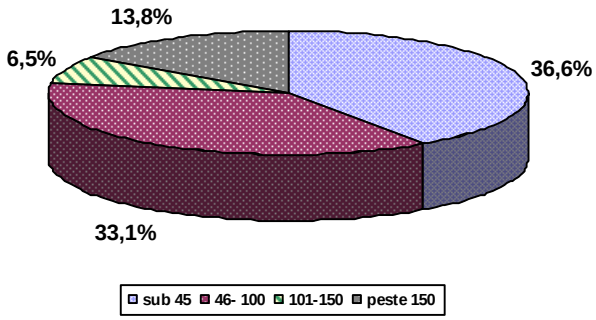
Figure no. 2. The distribution of the analyzed water samples after the nitrates concentration (mg/l) in rural localities from the two risk groups (p. 100 from the total analyzed samples).

zone I n = 131



zona

zone II n = 145



2. The second period of time studied in the present paper was between the years 1997-2009. The monitorization of water quality in this period of time consists in examinations of water sources that appeared to generate acute intoxications with

nitrates. A general description of water supplies in the rural areas of the county, reveals some aspects regarding often poor quantitative situation and improper chemical and/or bacteriological.

The 79 rural localities of the county have a population over 380.000 inhabitants (53-55% from the total county population). Water supply in these localities, with some exceptions, is mostly through fountains (publics or individuals), in 2004 being registered 17.830 fountains in the county. On average, a fountain supplies almost 21-22 persons, meaning 4-5 families. The situation has a large territorial variability:

- almost 4% from the localities and 2,3% of inhabitants are practically the owners of a individual fountain, which supply only the own family;
- almost for the half of the rural localities (60% of the inhabitants), a fountain is for 26 consumers; in 15% of the localities and 20% of the population, a fountain is for 50 persons (Tab.2).

In the first category, the most favorable, there are the localities:

- Letea Veche with 2.7 persons,
- Vultureni with 3.8,
- Darmanesti with 4.7,
- Tamasi with 5.5 persons at a fountain.

The most disadvantaged localities:

- Balcani with 65.7 persons on water supply,
- Margineni 67.6,
- Valea Seaca 68.7,
- Glavanesti 69.7,
- Sascut 84.0,
- Hemeiusi 131.5.

In case of a chemical or bacteriological source of water contamination, the risk would spread to a large number of persons, of different ages and physiological or pathological statuses.

The specialized laboratories carried out water source examinations with different occasions but mostly in case of a acute methemoglobinemy appearance. Between 2002- 2003 were analyzed 710 water samples from 85 rural localities that represent 3.98% from the total registered fountains. The results revealed 27.5% improper samples with special mention for Plopana, Ungureni, Rosiori, Secuieni where from half to 9/10 of samples were contaminated with nitrates (tab 3).

Between the years 1997-2009, in Bacau were registered 291 cases of methemoglobinemy in infants, for whom the examination of water supply was achieved. There are a lot of missing data in the registration file of the case, either because in the first year, some data registration were not specified in the methodology or because of superficiality of registration.

The data of these investigations are showed below, with special mention on the undefined situation that are presented under this tag.

- type of fountain: public (38.8%), individual (19.1%), undefined (42.1%)
- deep of the fountain: under 10 m (42.5%), 10-20 m (30.6%), +20 m (2.9%), undefined (23.9%)
- the distance to latrines: under 10 m (6.2%), +10m (55.0%), undefined (38.8%)
- sanitary protection: yes (12.4%), no (42.6%), undefined (44.6%)
- nitrites concentration under 0.03/0.05 (45.5%), +0.03/0.05 (11.0%), undefined (43.5%)
- nitrates concentration: under 45/50 mg/l (17.7%), 46/51-100 (39.2%), 101-500 (41.6%), undefined (19.1%)
- fecal colli: under 2 (45.0%), +2 (22.0%) undefined (33.0%)
- fecal streptococcus: under 2 (44.5%), +2 (6.7%), undefined (48.8%)

Even if there are so many missing data collected, there are still defined a lot of situation when construction, emplacement, protection or maintain the fountain are inadequate and also when the quality of water is improper chemical or bacteriological, in rural areas where there are no other alternatives for population water supply.

Between 1997-2009, in localities Blagesti, Horgesti, Luizi Calugara and Plopana were registered a large number of cases with methemoglobinemy (36 cases) and a lot of water quality investigations were carried out. A number of 76 water sample were analyzed, representing 7.6% of the total fountains from the four localities. An important proportion of improper quality water was found, over 86%, mostly because the investigations were conducted for the water supplies incriminated to generate the intoxication for children. For the majority of cases, the concentration of nitrates exceeded 2-3 times the MAD (tab 4).

The maximum concentration of nitrates was found in 2006 in the village Budesti, Plopana locality (317 mg/l). There was not registered nitrite above the norm, with one exception of a fountain in Plopana in 2006, when the quantity of nitrites was 0.62 mg/l.

Even if it appear to lack the sustenability in the monitorization process of water quality, the data collected helped to draw a map of Bacau county with areas at risk.

Collecting the data of acute methemoglobinemy incidence for a long period of time, is the first step in an epidemiological study which analyze the causality relationship between water contamination with nitrates and the late, chronic effects on the vulnerable persons (children under 3 yo and pregnants).

CONCLUSIONS

Measuring the concentration of contaminants in environmental elements is the first step in designing the studies of environmental epidemiology. These measures should be necessary followed by revealing the effects of these contaminants on the health status of exposed population.

Nitrites and nitrates from drinking water are responsible of acute effects but also of chronic effects, due to moderate concentration but with a long history of usage.

Monitoring the quality of drinking water in the rural area, the current activity of preventive medical services until 1993-1995, it is now carry out just in case of registration of acute intoxication in infants.

The present paper is a summary of investigations of water quality in Bacau county, in the previous period and in the last 13-15 years.

A general view of water supplies in rural area reveal poor quantitative situations and frequent contamination of water with nitrates, associated sometimes with bacteriological contaminations.

There are a lot of missing data, still, the information provided by water investigations were the starting point in drawing the map of risky localities in Bacau county.

The conclusions of this quality water monitoring, will help to improve the collecting information system and also for the file registration for the cases of methemoglobinemy with integrated data about exposure and the effects of the exposure.

Collecting data is also a first step for some epidemiological studies in areas with a high risk in Bacau county.

Table no. 1. Nitrates values in the well water in the rural localities in Bacau county in different stages of investigation

No. Samples	NO_3 under 45	46-100	101-150	151-200	201-250	+250
1983						
311	252	37	13	4	1	4
p.100	**81.0**	**11.9**	**4.2**	**1.3**	**0.3**	**1.3**
Localities		Horgesti, Pincesti, Corbasca	Traian Tamasi	Racova V.Seaca	P.Turcului	Damienesti, Ungureni, Colonesti, Pancesti
March 1988						
112	52	39	7	4	7	3
p.100	**46.4**	**34.8**	**6.3**	**3.6**	**6.3**	**2.7**
Localities			Ungureni, Secuieni	Filipeni, Tataresti	Filipeni, Plopana Parincea	Secuieni, Motoseni
June 1988						
112	64	30	8	4	6	-
p.100	**57.1**	**26.8**	**7.1**	**3.6**	**5.4**	-
Localities				Parincea, Filipeni, Asau, Secuieni	Pincesti, Secuieni, Rachitoasa	

*) Source: M. Bustuc – PHD Thesis, UMF Iasi ,1988

Table no. 2. The distribution of the localities and inhabitants from the rural environmentafter the number of consumers for a water source p. 100 in the year 2004, in Bacău county

no.consumers for a supply/fountain	no.localities		no.inhabitants	
	c.a	p.100 from total	c.a	p.100 from total
under 5 persons/ fountain	**3**	**3,79**	**8893**	**2,31**
5 – 15 pers.	19	24,05	*65855*	17,09
16 – 25	17	21,52	81193	21,06
26 – 50	28	35,44	155692	40,39
50 + persons/ fountain	12	15,19	73805	19,15
TOTAL	**79**	**99,99**	**385438**	**100,00**

Table no. 3. Number of the analyzed samples, number of theimproper samples in Bacau county during the period 2002-2003

Locality	no.analyzed samples	no.improper samples
Plopana	15	14
Ungureni	15	11
Motoşeni	12	8
Secuieni	29	16
Roşiori	14	9
Onceşti	19	10
Hemeiuş	12	6
Parava	12	6
Luizi Călugăra	8	4
Total	**710**	**195 = 27, 5 %**

Table no. 4. The results of lab analyzes for fountains water from 4 localities during 1997-2009

Locality	No of fountains in localities	No. analyzed samples	% from total	no. improper samples	concentration of nitrates (mg/l)				
					< 50	51-100	101-150	151-200	>200
Blageşti	152	26	17,1	23	3	13	6	2	2
Horgeşti	351	11	3,1	10	1	5	3	1	1
Luizi	175	14	8,0	11	3	4	5	1	1
Plopana	324	25	7,7	22	3	13	5	3	1
TOTAL c.a.	**1002**	**76**		**66**	**10**	**35**	**19**	**7**	**5**
p. 100			**7,58**	**86,8**	**13,1**	**46,0**	**25,0**	**9,2**	**6,6**

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