POTENTIAL NITRIC POLLUTION SOURCE OF DRINKING WATER FROM RURAL WELLS

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Abstract *The paper presents the results of intensive agricultural practices on the quality of depth waters found frequently as drinking water in rural wells.In areas with intensive nitrogen fertilization and livestock breeding, groundwater becomes overloaded with nitrates. In this research, nitrate contamination generated by intensive agricultural technologies as well as nitric overload due to intensive animal breeding were studied on groundwater samples.The upper and deep layers of groundwater in several locations of Banat County, well known for the industrial livestock breeding and intensive agricultural practices, were collected and analyzed for nitrates, using the GRIESS method. Nitrates from water samples were determined by using standard methods, as atomic absorption spectrometry (AAS). The water samples were taken from wells and drillings located in rural regions of Banat County, Jimbolia, Bobda, Dinias, Folea Tormac, Nitchidorf and Margina, where intensive agricultural activities were performed.The nitrate content of upper and deep layers groundwater from rural wells was established. In several analyzed wellwater samples from Banat County the upper layer and average depth groundwater proved frequently to be compromised due to intensive nitrogen fertilization and industrial animal breeding, exceeding the nitrate content in drinking water of 50 mg nitrate/ l water. The usefulness of the paper consists in preventing the consumer's nitric contamination by drinking water from rural wells.The importance of the obtained results lies in informing the consumers about the nitrate content in depth water resources in areas of intensive fertilization with mineral nitrogen or industrial animal breeding.In order to avoid in time the appearance of nitrate-induced serious consequences on human health, FAO and WHO have established the daily acceptable intake of nitrate to 3,65 mg nitrate/kg body mass, meaning also 50 mg nitrate/ l in drinking water. Exceeding the toxicity limit mentioned above, may induce serious illness like methaemoglobinaemia and cancer.*

Keywords: *rural wells, groundwater, nitrate content, nitric overload, industrial animal breeding,*

INTRODUCTION

Ensuring important quantities of animal origin food by obtaining a large increase in production in the shortest possible time has led to changes in the traditional system of animal husbandry and the emergence of the intensive system of raising them in industrial complexes (3, 9, 10). Maintaining in the shelters the best hygienic-sanitary conditions and at the same time saving the work sheet determined the introduction of a hydraulic manure removal system. Thus, the mixture of manure, urine, food residues, bedding material is diluted with washing water becoming wastewater. The resulted wastewater has an average volume 6-8 times greater than the actual amount of the resulted manure. The polluting potential of wastewater resulting from animal husbandry complexes is due both to their composition (nitrate content) and especially to their volumes, depending on the animal numbers. Frequent management of wastewater from intensive livestock complexes in the irrigation of agricultural land has depreciate the quality of groundwater in the area (3, 5, 6, 8, 9, 10). Regarding the depreciation of the groundwater, it is especially noticeable in the areas adjacent to the industrial complexes or farms with a low groundwater table, a stronger depreciation of the groundwater characteristics at a shallow level compared to the deep ones(6,8,10,11). It is known that in

rural areas drinking water is assured through wells where the water is provided from groundwater or shallow water. Regarding the nitrate content of food, the daily intake of nitrates may often be raised by drinking water (well water) containing high nitrates amounts, especially in rural areas (4,7,12).

In order to establish the main reason of nitrate contamination in well water from rural areas, the influence of waste water composition and volume provided by the animal husbandry complexes was examined. The main objective of this study is to establish the nitrate content variation in well water because soil irrigation with waste water resulted in industrial complexes of animal breeding or intensive agricultural practices.

MATERIAL AND METHODS

Water samples were collected from wells and drillings located in Banat County, in areas adjacent to industrial complexes or agricultural farms, mostly having the groundwater table close to the soil surface. The nitrate content of upper and deep layers ground water was investigated. Waste water samples were analyzed in order to determinate the dependence between the number of animals and nitrate/ nitrogen content as well as the impact of intensive agricultural activities mainly excessive nitrogen fertilization on groundwater quality.

The nitrate content (STAS 3048/1-77 SR ISO 7890/1-98) was determined by spectrophotometry at 538 nm using the GRIESS method (SR EN 12014-7:2001). The obtained results are discussed regarding the highest level of nitrates in drinking water (Rule-458/2002), in order not to exceed, by daily intake, the acceptable level of nitrates in human body.

RESULTS AND DISCUSSION

The research shows that the resulted wastewater determined by the introduction of a hydraulic manure removal system has an average volume 6-8 times greater than the actual amount of the resulted manure. The polluting potential of wastewater resulting from animal husbandry complexes is due both to their composition (nitrogen/nitrate content) and especially to their volumes, depending on the animal numbers (table 1).

Table 1

Correlation between animal number and resulted waste water volume /nitrogen / nitrate content

Animal number	Waste water volume (m3/day)	Waste water /total nitrogen content (t/year)	Waste water /nitrate content (t/year)
171500	7250	2304	68
160000	4500	1794	63
68000	1560	707	26
35000	1080	408	14
34000	950	149	0,19

Frequent management of wastewater from intensive livestock complexes in the irrigation of agricultural land has depreciated the quality of groundwater in the area. A direct correlation between animal number and resulted waste water volume used to irrigate the soil has had a negative impact on the quality of groundwater in the area mainly on the nitrate content. The high levels of nitrogen and nitrate content established in the wastewater composition used to irrigate de soil induces the increase of groundwater nitrate content (table 2).Regarding the depreciation of the groundwater, a stronger depreciation of the groundwater characteristics at a shallow level compared to the deep ones, was established. It is known that in rural areas drinking water is provided by wells supplied from groundwater or shallow water.

Table 2

Nitrogen/ nitrate distribution in waste water and groundwater depending on animal number

Animal number	Waste water /total nitrogen content (t/year)	Waste water /nitrate content (t/year)	Ground water nitrate content (mg/ l)
171500	2304	68	95,30
160000	1794	63	92,00
68000	707	26	91,81
35000	408	14	72,34
34000	149	0,19	31,00

In several rural localities of Banat County, the upper layer of ground water was compromised because of the intensive agricultural activities. In all the well water samples proceeded from 8 rural localities, mentioned below, the nitrate content exceeded the allowed content for drinking water, which is 50 mg/l (Rule-458/2002).The exceed of nitrate content in drinking water alters between 10-1100 % which rises the daily intake of nitrates by drinking water (well water)(table 3).

Table 3

Nitrate contamination in the upper layers of depth waters in areas with intensive agricultural activities in Banat County

Settlement	Nitrate content (mg/l)	Exceeded acceptable level (%)
Jimbolia	56	12
Bobda	94	88
Dinias	55	10
Urseni unip	98	96
Folea	58	16
Tormac	138	176
Nitchidorf	600	1100
Margina	88	76

The obtained results concluded that both upper layers of the groundwater and most of the drillings made at 40-60 m depth, close by the livestock breeding farms were compromised. Because intensive animal breeding in most of the rural localities,several of them mentioned in table 4, the groundwater could not be used as drinking water because of the high nitrate content, which exceeds the allowed level in drinking water (table 4).

Table 4

Nitrate overload of depth waters in Banat County due to intensive animal breeding

Settlement	Nitrate content (mg/l)	Exceeded acceptable level (%)
Alios	100	100
Masloc	120	140
Pischia	130	160
Sanandrei	140	180
Periam	120	140
Peciu Nou	110	120
Deta	96	92
Gataia	46	-

The magnitude and depth of the nitrate pollution phenomenon by nitric loading due to the activity of industrial animal husbandry in the county is revealed by the data obtained on the nitrate content in deep drilling. Water samples taken in 3 localities covering the western county show through the determined nitrate content the compromise of the drinking water reserves even at great depth. In Hodoni, drillings made at a depth of 152 m, shows in water samples a nitrate content which exceeds the allowed level in drinking water by 60 % (table 5).

Table 5

Ground water (deep layers) nitrate content in the areas adjacent to the industrial complexes or farms

Settlement	Drilling depth (m)	Nitrate content (mg/l)	Exceeded acceptable level (%)
Hodoni	152	80	60
Peciu Nou	127	53	6
Jamu Mare	120	47	-

CONCLUSIONS

The study presents the results of intensive agricultural practices on the quality of depth waters found frequently as drinking water in rural wells.In areas with intensive nitrogen fertilization and livestock breeding, groundwater becomes overloaded with nitrates.

In this paper, the existence of high nitrate levels in areas of intensive agricultural activities as well as due to intensive animal breeding were studied on groundwater samples.The upper and deep layers of groundwater in several localities of Banat County, well known for the industrial livestock breeding and intensive agricultural practices, are analyzed.

The resulted wastewater has an average volume 6-8 times greater than the actual amount of the resulted manure. The polluting potential of wastewater resulting from animal husbandry complexes is due both to their composition (nitrate content) and especially to their volumes, depending on the animal numbers. Frequent management of wastewater from intensive livestock complexes in the irrigation of agricultural land has depreciated the quality of groundwater in the area. The high nitrogen and nitrate content established in the wastewater composition used to irrigate de soil induces the increase of groundwater nitrate content.

Nitrate contamination in the upper layers of depth waters in areas with intensive agricultural activities in Banat County show an exceed of nitrate content in drinking water altering between 10-1100 % which rises the consumers daily intake of nitrates by drinking water (well water).

Not only the upper layers of the groundwater were compromised but also most of the drillings made at 40-60 m depth in the vicinity of the livestock breeding farms. The groundwater could not be used as drinking water because of the high nitrate content, which exceeds the allowed level in drinking water.

Water samples taken in 3 localities covering the western county show through the determined nitrate content the compromise of the drinking water reserves even at great depth. Thus, drillings made at a depth of 152 m, shows in water samples a nitrate content which exceeds the allowed level in drinking water by 60 %.

To prevent the effect of high nitrate content on the consumers' health, the daily intake of nitrates may not exceed the allowed level, established by FAO and WHO as daily acceptable intake of nitrate to 3,65 mg/kg body mass (4). There fore the nitrate content and the amount of ingested food and drinking water must be taken into account. The present results indicate that

drinking water provided by wells, supplied from groundwater or shallow water, can become frequently as drinking water in rural wells, in areas with intensive nitrogen fertilization and livestock breeding, overloaded with nitrates. The paper shows, that nitrate contamination in areas of intensive agricultural activities as well as nitrate overload due to intensive animal breeding, may induce by drinking water serious illnesses like methaemoglobinemia and cancer.

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