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CONTRIBUTIONS TO THE KNOWLEDGE OF SOME PHYSICO-CHEMICAL, CHEMICAL AND BIOLOGICAL CHARACTERISTICS OF THE WATER IN THE NICOLINA RIVER

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Abstract: This paper aims at underlying some physico - chemical, chemical and biological characteristics of the water in the Nicolina River in Iasi city area. Field observations and physical – chemical and chemical analysis of water samples were performed; the species of algae were identified. The results obtained emphasize specific values of the analyzed indicators (pH, conductivity, TDS) according to the interval of time and the station of water sampling. The water pH is mainly slightly alkaline; The conductivity and TDS values indicate a high degree of mineralization. We identified 74 taxa of algae belonging to six groups: Cyanophyta, Bacillariophyta, Euglenophyta, Zygnematophyta, Chlorophyta and Chrysophyta. The results obtained and the algal taxons identified underlie the existence of some human influence on the river water in the analysed sector.
Keywords: physical / chemical indicators, algal taxa, Nicolina River .

Introduction

River Nicolina is an important tributary of river Bahlui. The water basin of river Nicolina is located in the southern part of Moldova Field, where it meets the Central Moldavian Plateau (Cojocaru, 2008). River Nicolina springs from an area in the north-east of Hill Poiana Movilei, at an altitude of 352 m (Minea, 2012); it flows in river Bahlui on the territory of Iasi City, in the area called Galata. It has a length of 20 km, a surface of the water basin of 117 km² (Minea, 2012); its surface represents 9 % of the basin of river Bahlui (Cojocaru, 2008).

It presents two tributaries on the left side (stream Valea Locei (Loca), stream Ezăreni), and a tributary on the right side (stream Bârnova). On the course of the river and its tributaries there are several accumulations of water: not permanent (Ciurea, Bârca, Cornet) and permanent (Ciurbeşti and Ezăreni) (https://www.prefecturaiasi.ro/).

The river with its areas of protection, regularized inside, is important as entertainment area, green and humid space for the inhabitants of the areas C.U.G., Nicolina II, Nicolina I, Galata, and Mircea cel Bătrân, until its flow into the river Bahlui. Starting with the production halls of the former company Fortus SA and until the confluence with the river Bahlui on the water course of Nicolina there are six small bridges for persons and for bridges of the vehicle traffic.

It is known the fact that the productivity of the running underwater ecosystem depends on the quantity of nutrients transported (Stanley and Ward, 1997) and the quantity of organic matter (Mann and Wetzel, 1995) based in most cases on the human activity in the river area. Along the river Nicolina, on the length that crosses Iasi city, the human

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activity with important influence on the quality of the water is abandoning different types of domestic waste or throwing waste water in the river.

This area of the river, having on both sides houses or blocks of flats, faces threats because of the human activity, as it happens along rivers in the whole world (Gopal and Chauhan, 2001). The polluting elements in the dry area along the river are transported in its water by the rain water.

The water resource of river Nicolina, as well as the neighbouring terraced areas are used mainly for entertainment and sportive fishing. The rich vegetation on the shores is eaten by horses or cut and used as food for cattle. In the area called Nicolina II, Galata on both sides of the river, there are houses. Domestic birds such as ducks and geese in households are freed and can be often seen on water, contributing with organic substances to the water.

This work wants to underline some physical-chemical, chemical and biological characteristics of the water in river Nicolina in Iasi city area. From 2009, river Nicolina has been included in the national network of monitoring the water quality in the water basin Prut-Bârlad.

The basin of the Nicolina river and, respectively, (in some cases) only its middle and lower sector represented the object of some studies of geomorphological (Cojocaru, 2008), hydrological (Minea, 2012) and chemical (Seliman et al., 2009; Oişte and Breabăn, 2011; 2013) interest.

Materials and methods

Determinations have been done on water samples, periodically taken in May (noted: sample I – 1 May; sample II – 6 May) and June 2011(noted: sample III – 1 June). The samples of water were taken from four different area (sampling stations) located on the lower course of river Nicolina: station 1 – area of the former halls of production of SC Fortus SA; station 2 – area Nicolina II, neighbourhood of the bridge for vehicle traffic; station 3 – neighbourhood Galata, near the traffic bridge; station 4 – area located about 10 m from the meeting point of Nicolina and Bahlui river.

The following physico-chemical parameters were considered in the study: pH, conductivity (measured with a multi-meter of type Consort C532), the total content of solid substances dissolved (measured with a TDS-meter). For the three indicators (pH, TDS, and conductivity), also the coefficient of variation was calculated according to the method described by Zamfirescu and Zamfirescu (2008). Qualitative determinations were done for sulphates and nitrites (Zamfirache et al., 1997).

The species of algae were identified in the samples of water taken in the sector analysed. For the identification of the species, microscopic observations were done by means of an Olympus microscope. The water samples were examined in fresh and preserved condition in formalin 4%. The determinations were done using the determinators published by Ettl (1978), Hindak (1977; 1980), Starmach (1966), Sieminska (1966). Also, field observations were done.

Results and discussions

It is known the fact that the physical and chemical characteristics of the river water are determined by several factors: the mineral composition of the rocks in the areas the river crosses, the regime of the precipitations, temperature, relations with underground waters, seasonal variation of the debit, etc.

pH (Table 1). It is an important indicator to estimate the water quality; it influences the life of the aquatic organisms. In the unpolluted waters, the pH is controlled by the proportion of carbon dioxide, carbonate and bicarbonate ions. During the investigations, the values of the pH varied from 7.37 to 8.49 (neutral to slightly alkaline), values below the admissible maximum concentration (value 8.5), according to the Order of Ministry 161/2006.

The variation coefficient (CV %) has low values, comprised between 1.42 % (the case of the water samples taken from station 3) and 7.77 % (the case of the water samples taken from station 4); in general, variability is low (Table 2).

Table 1. Indicators studied

Sample Nr.	Indicators	Sampling station			
		1	2	3	4
Sampling I- May 1st 2011	pH	8,19	8,37	8,49	7,37
	TDS (ppm)	595	605	603	635
	Conductivity (µS/cm	659	665	674	693
	Sulphates	+	+	+	+
	Nitrites	+	+	+	+
Sampling II- May 16th 2011	pH	7,71	7,90	8,27	8,48
	TDS (ppm)	665	637	636	636
	Conductivity (µS/cm	742	724	733	746
	Sulphates	+	+	+	+
	Nitrites	+	+	+	+
Sampling III- June 1st 2011	pH	8,19	8,3	8,49	8,47
	TDS (ppm)	744	639	626	621
	Conductivity (µS/cm	854	767	757	753
	Sulphates	+	+	+	+
	Nitrites	+	+	+	+

Table 2. The coefficient of variation (CV%)

Sampling station	pH		Conductivity		TDS	
	Average	CV%	Average	CV%	Average	CV%
1	8,03	3,36	751,66	13,01	668	11,15
2	8,19	3,05	718,66	7,12	627	3,04
3	8,41	1,42	721,33	5,92	621,66	2,72
4	8,10	7,77	730,66	4,48	630,66	1,33

Conductivity and TDS. Conductivity is one of the indicators used to estimate the degree of water mineralization. It presented values comprised between 659 µS (first sampling SI) and 854 µS (sampling III S1). The potential sources of pollution, such as waste water, etc., increase the concentration of ions in the water and the conductivity.

TDS presented values between 595 ppm – 744 ppm. Low value variations are noted from one station to another (for the first two samplings), respectively higher value variations, for the third sampling. Based on the values recorded for conductivity and TDS, we estimate that the water of river Nicolina in the area analysed presents a high mineralization degree.

Also, we mention the fact that the geologic sub-layer of basin Nicolina influences the chemical characteristics of the river sediments, the physical and chemical characteristics of the surface water. To these, the leakage from the land is added. According to Pantazică (1974), the degree of water mineralisation depends on a series of local geographical factors (precipitations, types of soil, temperature, etc). According to the content of salts, the river waters in the basin of Bahlui river are waters with high mineralisation (500mg/l - 1000mg/l)/ very high (≥1000mg/l).

The coefficient of variation for conductivity and TDS is not higher than 30%, which indicates the fact that these parameters vary in value a little within the same station of sampling, and also from one station to another, for the whole period of sampling (the average value obtained is representative) (Table 2).

The sulphates and the nitrites were present in all the water samples. The sulphate ion has an important role in the mineralisation of the river water in the Bahlui basin (16-28 %) (Minea I., 2009). Nitrites represent an important stage in the metabolism of the nitrogen compounds. They interfere in the bio-geo-chemical cycle of nitrogen, as intermediate stage between the ammonia and nitrates. Research done by Oişte and Breabăn (2013) indicated for the water of river Nicolina a high content of nitrates and reduced of phosphates and ammonia in December 2010 and June 2011.

Modifications of the water chemistry generate modifications of the water biocenosis. The algae in general and the phytoplankton as a specific group present rapid and predictable answers to a varied range of polluting substances, and can offer information regarding the deterioration of the quality of the water and its possible causes (Rishi and Awasthi 2012). According to the Water Frame Directive 60⁄2000⁄E (http //:www.mmediu.ro), the algae represent one of the biological elements used to estimate the ecological state of the surface of the water bodies.

The algal taxa identified in the water samples taken during the period studied are presented on table 3. We identified 74 taxa of algae belonging to six groups: Cyanophyta (3 taxa), Bacillariophyta (33 taxa), Euglenophyta (8 taxa), Zygnematophyta (1 taxon), Chlorophyta (27 taxa) and Chrysophyta (2 taxa).

The fact that the diatoms and chlorophytes are best represented is noticed. This fact is probably due, according to some authors (Patrick, 1973), to the slightly alkaline pH and the presence in the river water of nitrites, nitrates and phosphates.

Analysing comparatively the results obtained separately for each sampling, the fact that the number of taxons identified is rather large is noticed, with minor differences from one sampling to another: 41 taxa for the first water sampling; 39 taxa for the second water sampling; 43 taxa for the third sampling.

Among all the identified taxa, 30 are on the list of quality indicators of water, presented by Surugiu (2008) (adaptation after Sládeĉek, 1976).

The species of algae as biological indicators of water quality, species identified by us for each water sampling, respectively for each station, are given further in the text.

For each species we indicate: the degree of saprobity (s) and indicating value (g) according to the information presented by Surugiu ((2008) (adaptation after Sládeĉek, 1976); the number of sampling (I, II, III) and the station of sampling (S1- 4).

Table 3. The taxa of algae identified in the sector of river analysed

Nr. Crt.	Phylum / Taxa	Sampling I– 1st May/Station				Sampling II– 16th May/Station				Sampling III– 1st June/Station			
		S1	S2	S3	S4	S1	S2	S3	S4	S1	S2	S3	S4
	Cyanophyta												
1	*Anabaena* sp.	+	+	+	+	+	+	+	+	+	+	+	+
2	*Oscillatoria limosa* Agardh ex Gomont			+					+				
3	*Oscillatoria limnetica* Lemmerman									+			
	Chrysophyta												
1	*Synura* sp.			+		+	+	+					
2	*Dynobryon sertularia* Ehrenberg		+				+						
	Bacillariophyta												
1	*Achnantes* sp.											+	+
2	*Amphipleura* sp.			+				+					
3	*Anomoeoneis sphaerophora* (Ehr.) Pfitzer			+					+	+			
4	*Bacillaria paradoxa* J. F. Gmelin											+	+
5	*Cocconeis* sp.											+	
6	*Cyclotela meneghiniana* Kurtz.	+	+	+	+	+	+	+	+	+		+	+
7	*Cyclotella comta* (Ehr.) Kutz.										+		+
8	*Cymatopleura solea* (Bréb.) W. Sm.			+		+	+	+	+				
9	*Cymbella* sp.			+				+	+	+		+	
10	*Fragillaria* sp.			+								+	
11	*Hantzschia amphioxys* (Ehrenb.) Grunow				+								
12	*Hantzschia* sp.											+	
13	*Melosira* sp.						+						
14	*Melosira varians* Agardh											+	
15	*Navicula cryptocephala* Kutz.				+								
16	*Navicula cuspidata* (Kuetzing) Kuetzing	+											
17	*Navicula formosa* Gregory.			+									
18	*Navicula gracilis* Ehrenberg					+							
19	*Navicula* sp.	+		+	+	+	+	+	+	+	+	+	+
20	*Nitzschia acicularis* (Kützing) W. Smith	+	+	+	+		+		+	+	+	+	

21	*Nitzschia fruticosa* Hustedt.	+											
22	*Nitzschia longissima* (Brébisson) Ralfs.							+					
23	*Nitzschia obtusa* W. Smith			+	+						+		
24	*Nitzschia sigmoidea* (Nitszch) W. Smith	+	+	+			+	+	+	+			
25	*Nitzschia* sp.											+	
26	*Pinnularia* sp.			+					+				
27	*Pleurosigma* sp.								+				
28	*Rhoicosphaenia curvata* (Kutz.) Grun.											+	+
29	*Synedra acus* Kutz.					+	+						
30	*Synedra ulna* (Nitz.) Ehr.		+	+	+			+		+	+	+	
31	*Stauroneis* sp.			+									
32	*Surirella ovata* Kutz					+		+					
33	*Tabellaria fenestrata* (Lyngb.) Kutz				+								
	Xanthophyta												
1	*Tribonema viride* Pascher								+				
	Euglenophyta												
1	*Euglena acus* (O. F. Müller) Ehrenberg			+			+	+	+	+		+	
2	*Euglena mutabilis* Schmitz					+							
3	*Euglena viridis* O. F. Müller) Ehrenberg	+	+	+						+	+	+	+
4	*Phacus acuminatus* A. Stokes									+	+	+	+
5	*Phacus pleuronectes* (O. F. Müller) Nitzsch ex Dujardin			+									
6	*Phacus pyrum* (Ehrenberg) W. Archer									+	+	+	+
7	*Phacus* sp.					+							
8	*Trachelomonas hispida* (Perty) Stein	+	+	+	+	+	+	+	+	+	+	+	+
	Zygnematophyta												
1	*Closterium acutum* Brébisson									+			
	Chlorophyta												
1	*Actinastrum hantzschii* Lagerheim	+	+	+				+		+	+	+	+
2	*Ankistrodesmus* sp.			+									
3	*Coelastrum microporum* Nageli in A. Braun									+	+	+	+
4	*Chlorella vulgaris* Beijerinck	+	+			+		+					

5	*Gonium pectorale* Müller	+	+	+		+	+	+	+		+	+	
6	*Goniochloris* sp.				+								
7	*Kirchneriella lunaris* (Kirchner) Möbius									+	+	+	
8	*Lagerheimia genevensis* (Chodat) Chodat							+					
9	*Monoraphidium-griffithii* (Berkeley) Komárková-Legnerová			+	+	+	+	+	+	+	+	+	+
10	*Micractinium pusillum* Fresenius	+	+							+	+	+	
11	*Oedogonium* sp.											+	+
12	*Oocystis lacustris* Chodat	+	+				+						
13	*Pandorina morum* (Müller) Bory			+									
14	*Pediastrum boryanum* (Turpin) Meneghini		+				+				+	+	+
15	*Pediastrum tetras* (Ehrenberg) Ralfs				+							+	
16	*Polyedriopsis spinulosa* (Schmidle) Schmidle												+
17	*Selenastrum* sp.	+			+		+		+				
18	*Scenedesmus acuminatus* (Lagerkeim) Chodat	+	+	+	+					+	+	+	+
19	*Scenedesmus acutus* Meyen							+	+				
20	*Scenedesmus dimorphus* (Turpin) Kutz.					+	+	+	+				
21	*Scenedesmus quadricauda* (Turpin) Brebisson	+	+	+		+	+	+	+	+	+	+	+
22	*Scenedesmus sempervirens* Chodat											+	
23	*Scenedesmus spinosus* Chodat	+											
24	*Sphaerocystis* sp.					+							
25	*Tetraedron minimum* (A. Braun) Hansgirg					+		+	+	+	+		
26	*Tetraedron trigonum* (Nageli) Hansgirg	+	+						+		+	+	
27	*Tetrastrum* sp.									+			

+ indicates the presence of the taxon in the sampling station

The indicator species of water quality: *Oscillatoria limosa* (β-α, 2)- I S3, II S4; *Dynobryon sertularia (*o, 4)- I S2, II S2; *Cyclotella meneghiniana* (β-α, 3) – I S1- 4, II S1-4, III S1, 3, 4; *Cymatopleura solea* (β-α, 2) – I S1-3, II S1-4; *Melosira varians (*o-β, 2) – II S2; *Navicula cryptocephala* (α, 4) –I S4; *Nitzschia acicularis* (α, 4)- I S1- 4; II S2, 4; III S1; *Nitzschia sigmoidea* (β, 4) – I S1-3, II S2 - 4, III S1; *Rhoicosphaenia curvata* (β, 2) –III S3,4; *Euglena acus* (β-α, 3) – I S1-3, II S2-4, III S1, 3; *Synedra ulna* (x- α, 1) – I S2- 4, II S3, III S1-3; *Tabellaria fenestrata* (o-β, 3)- I S4; *Tribonema viride* (o-α, 2) – II S4; *Euglena acus* (β-α, 3) – I S1-3, II S2-4, III S1, 3; *Euglena viridis (*p- α, 2) – I S1-3; III S1- 4; *Trachelomonas hispida* (β, 3) – all stations and samplings; *Actinastrum hantzschii* (β, 4) – I

S1-3, II 3, III S1- 4; *Chlorella vulgaris (*p-α, 3) – I S1, 2; II S1, 3; *Coelastrum microporum* (β, 4) – III S1- 4; *Gonium pectorale* (α-p, 2)- I S1-3; II S1- 4; III S 2, 3; *Kirchneriella lunaris* (β, 5) – III S1-3; *Micractinium pusillum* (β, 4); I S1, 2; III S1-3; *Oocystis lacustris* (o- β, 3) – I S1, 2; II S2; *Pandorina morum* (β, 3) – I S3; *Pediastrum boryanum* (β, 3) – I S2, II S2, III S2- 4, *Pediastrum tetras* (β, 3) –I S4, III S3; *Scenedesmus quadricauda* (β, 3) – I S1-3; II S1- 4; III S1- 4; *Scenedesmus acutus* (β, 5) – II S3, 4; *Scenedesmus sempervirens* (β, 5) – III S3.

From the information presented, the following aspects are underlined: the indicator species identified for the first sampling are specific to the β-mezosaprobic area corresponding to class II of quality (water moderately polluted from the viewpoint of the content of biodegradable organic matter); species of algae determined for the second sampling are specific to the β-α mezosaprobic area with tendencies towards the α-mezosaprobic area, corresponding to class III of quality (water very polluted with organic substances); most indicator species identified in the last water sampling are specific to the β-mezosaprobic area.

The results obtained and the observations done in the field enable us consider the fact that, for the area of the river analysed, the algae diversity depends on the physical and chemical characteristics of the water; these water characteristics can be influenced by the human activities done by the population living by the river: the deposit of waste directly in the water or on shores, throwing waste water, leisure activities.

Conclusions

The physico-chemical indicators present specific values variations, according to the interval analysed and the station of sampling. The water pH is mainly slightly alkaline; the values recorded are below the admissible maximum concentration. Conductivity and TDS values indicate a high degree of mineralization; this result is especially visible in the water samples from stations 1 and 4.

During the period analysed, the quality of the river Nicolina estimated based on the results obtained after the analysis of algal flora registered important fluctuations. The diatoms and chlorophytes are noticed for the highest number of taxa, fact that may be due, according some information in the field, to the slightly alkaline pH and the high degree of mineralization.

During the period analysed, in the water there were mainly species of seaweed characteristic to the β-mezosaprobic area (first and third sampling), respectively the α-mezosaprobic area (the second sampling). Taxa of algae identified underline the existence of a human influence on the river water in the area analysed.

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