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Analysis of the Szczecin Lagoon waters fungi

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Quantitative and qualitative analysis of the Szczecin Lagoon waters was carried out between April and December 1996. Changes in yeasts numbers of this particular estuary were found to be typical for the marine and estuary waters with maximum concentration of yeast-like fungi in the summer season. Qualitative analysis of the isolated strains, proved *Rhodotorula glutinis* to be the most frequently isolated species at the three sampling sites, with *Candida coliculosa* dominating at the forth one.

Key words: yeasts, yeast-like organisms, Szczecin Lagoon, water fungi.

INTRODUCTION

Yeasts and yeasts-like organisms are natural components of lakes, rivers and oceans fungi. Their presence depends, mainly, on hydrobio-chemical conditions of the water basins. Most of them are resistant to even great fluctuation in temperature, pH or hydrostatic pressure. They are usually plentiful in the environment rich in organic matter. From the mycological point of view, waters, due to increasing pollution with organic matter, loose gradually the characteristics of natural environment and become fluid, easy available source of nutrition (B a t k o 1975). This is why in waters enriched with large quantities of municipal sewages bacteria are accompanied, usually, with a variety of fungi, particularly yeasts and yeasts-like organisms (R e i n h e i m e r 1977). An adaptation ability of these microorganisms to changing environmental conditions result in their widespreading.

The mycologists have become, more often lately, to draw their attention to role of yeasts as a potential microbiological indicator of water pollution

(D y n o w s k a 1995; S i m a r d and B l a c k w o o d 1971). Basic information on the yeasts, so far, has been based, mainly, on the data obtained and applied in biotechnology and industry. However their role seems to be essential also in the natural environment. It is obvious for yeasts to take an active part in the metabolic processes, in the heterotrophic denitrification processes in the sewage treatment plant (S l a v i k o v á et. al. 1992) and in cumulation of the heavy metals from the environment. Due to increasing process of environmental pollution, water environment including, an interest in biology and physiology of yeasts has increased, lately. Environmental surveys on yeasts were conducted, mostly, in the freshwater basins. Some works only were addressed to marine waters as well as to the brackish ones. The estuary waters, due to their biological and hydrochemical specificity, differ essentially from the freshwater and marine water environments.

The present work presents data on occurence of yeasts and yeasts-like organisms in waters of the Szczecin Lagoon. This particular water basin is a sea-coast, flow lake which, together with the river-borne waters, sounds and the Pomeranian Bay, forms broad and very differentiated estuary. There is no data on fungi of this particular water basin available, so far.

MATERIAL AND METHODS

The subject of surveys were water samples collected at the Szczecin Lagoon, at its Polish part called the Great Lagoon. Water samples were collected asseptically with a gravity corer of our own , from the deck of the research vessel unit of Szczecin Maritime Council. Samples were collected at 4 different sampling stations (Fig. 1), marked as WWE, BT3, MOS and W4, which differed essentially. The differences included: type of the bottom, domination of sedimentatory or erosive processes, hydrochemical and biological conditions of the area, etc. The sampling sites, marked at the map below, were named after the buoys names anchored within the basin by the Marine Office. Each time their location was accurately determined by the satellite direction finder.

Samples were collected monthly, between April and December 1996, from three water layers: subsurface, middle and the bottom one. When collected into sterile containers and transfered, in a cold box, to the laboratory, were analysed immediately. A 100 ml subsample was filtered through the black, sterile, membrane filters with the 0.6 μm pores (Millipore) (V ä ä t ä n e n 1976; M a c i e j o w s k a 1981). Filters transfered onto the YM medium with gentamycine and streptomycine were incubated for 5 days at +20°C, according to M a c G i l l i v r a y and S h i a r i s (1993). The grown up colonies were counted, confirmed microscopically, tested for purity, than subcultured

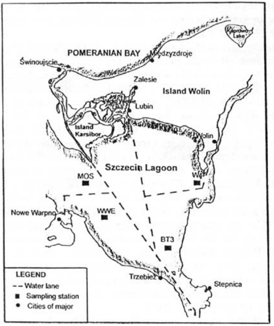

Fig. 1. Spacing of sampling station on Szczecin Lagoon

and identified according to L o d d e r (1970) and ID 32C API-tests of the "bio-Merieux".

Based on the number of colonies the colony forming units – CFU/100 ml of water was estimated and standard deviation for the sampling stations and experimental season determined. Interpretation of the results was based on one factor variance analysis with the confidence level 0.05.

RESULTS AND DISCUSSION

Quality of the waters of the Szczecin Lagoon is a result of mixing of the Odra river discharge and the runoff waters from the Pomeranian Bay. The Odra water discharge is the main source of the estuary waters pollution with municipal, industrial and rural type of contamination, which increase richness of the bottom limmiting the growth ability of the organisms more susceptible to increased contamination of this type. While waters of the Pomeranian Bay, by increasing slightly the water salinity, let the marine organisms introduced with waters to function within the Szczecin Lagoon, particularly within its more labile – outlet part.

The middle part of the estuary and the biggest part of the water basin, at the same time, inhabited, mainly, by the freshwater organisms with only few baltic species present, is the area of the most intesive biological production within the estuary (M a j e w s k i 1980). Fluctuations in physical, chemical and biological conditions effect, to a various extend , each of the sampling stations and bring evidence for a great specificity of this lake-estuary (M a j e w s k i 1980; M u t k o 1994, 1996). Among essential factors effecting the quantity and species variety of fungi are type of the water basin and level of its eutrophication (K o r n i ł ł o w i c z 1994). Authors present various opinions on when , within the year, the number of yeasts and yeast-like organisms increases (D y n o w s k a 1995; K o r n i ł ł o w i c z 1994; K w a ś n i e w s k a 1988; S l a v i k o v á et al. 1987). Most of the authors suggest the autumn to be the season when these organisms are most numerous. There are some differences when it comes to spring and the summer season. The data for the freshwater basins suggested the numbers of fungi in spring to be less numerous than the numbers noted for the autumn (N i e w o l a k 1973; Q u i n n 1984). However surveys on saline and estuary waters indicate there to be maximum in numbers of these organisms often in autumn and always in the summer season (M e y e r s et al. 1967; V e l e g r a k i-A b e l et al. 1987).

Results of our surveys, presented on Fig. 2, indicated there was no statistically significant differences in the average annual concentration of yeasts at the particular sampling sites. The study of monthly differences in yeast number noted, for the WWE water samples, that the increase of CFU/ml in October, was statistically unsignificant (Fig. 3). However, increase in CFU numbers noted at the sampling sites: MOS and W4 in July (Fig. 3) and at the BT3 in May and June (Fig. 3) proved to be statistically essential.

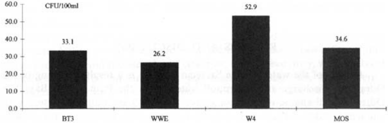

Fig. 2. Average annual concentration of yeasts and yeast-like organisms at each sampling site

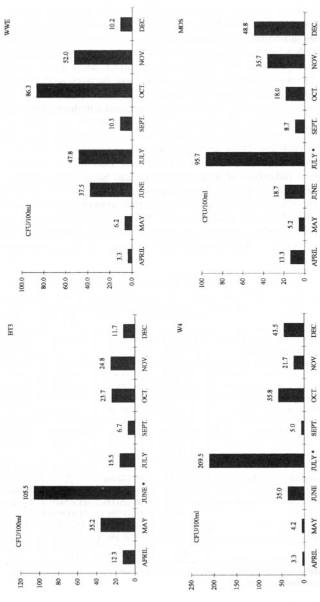

Fig. 3. Concentrations of yeasts and yeast-like organisms at the stations
*statistically significant

Peaks in yeast numbers noted for MOS and W4 sampling sites in the summer season (July) and for BT3 in the spring – summer time, proved the dynamic in fungi numbers changes of the Szczecin Lagoon to be characteristic for the brackish water basins. However lack of statistically essential differences in numbers of yeasts at the WWE station stayed unexplained. A slight, unessential increase noted in October could have been effected by marine waters on fungi of this particular station.

Species of yeasts being represented in the total numbers of the group differed (Tab. 1) *Candida coliculosa* was the strain isolated most often at the BT3 station while *Rhodotorula glutinis* dominated among isolated yeast species at the WWE, W4 and MOS sampling sites. According to Dynowska (1996) *Rhodotorula glutinis*, *Candida albicans* and *Trichosporon cutneum* are microbiological indicators of water contamination. Surprisingly enough, no essential increase in numbers of those species were noted at BT3 – the station nearest to the Odra river mouth, carrying raw sewages from the nearby Szczecin, inhabited by over 400.000 citizens. Nevertheless, numerous strains of *Rhodotorula glutinis* were isolated from the water samples collected on stations MOS, W4, WWE in a distance of 10–15 km from the Odra river mouth.

Table 1
Frequency of the yeasts species presence in water samples of the Szczecin Lagoon

Strain	Sampling site			
	BT3	WWE	W4	MOS
Candida colliculosa Meyer et Yarrow	**114 (18.24)***	56 (7.83)	57 (5.04)	50 (6.90)
Candida famata Nowak et Zoit	27 (4.32)	28 (3.92)	34 (3.00)	25 (3.45)
Candida glabrata Yarrow et Meyer	113 (10.08)	23 (3.53)	40 (3.53)	37 (5.10)
Candida lambica von Uden et Buckley	0 (0.00)	0 (0.00)	2 (0.18)	3 (0.41)
Candida sake von Uden et Buckley	40 (6.40)	64 (8.95)	43 (3.80)	45 (6.21)
Candida zeynoides Langeron et Guerra	30 (4.80)	9 (1.26)	4 (0.45)	4 (0.55)
Cklocera japonica Saito et Othani	0 (0.00)	2 (0.28)	1 (0.09)	7 (0.97)
Cryptococcus albidus Skinner	33 (5.28)	35 (4.90)	113 (9.98)	45 (6.21)
Cryptococcus laurenti Skinner	22 (3.52)	20 (2.80)	198 (17.49)	80 (11.03)
Cryptococcus neoformans Vuillemin	0 (0.00)	11 (1.54)	13 (1.15)	18 (2.48)
Hansenula saturnus Sydow et Sydow	8 (1.28)	8 (1.12)	15 (1.33)	3 (0.41)
NI**	83 (13.28)	84 (11.75)	86 (7.60)	82 (11.31)
Rhodotorula glutinis	59 (9.44)	**162 (22.66)**	**375 (33.13)**	**218 (30.07)**
Rhodotorula rubra Ledder	40 (6.40)	50 (5.99)	115 (10.16)	75 (10.34)
Saccharomyces cerevisiae Hansen	15 (2.40)	144 (20.14)	11 (0.97)	14 (1.93)
Sporobolomyces spp.	8 (91.28)	14 (1.96)	21 (1.86)	16 (2.21)
Trichosporon cutaneum Ota	12 (1.92)	4 (0.56)	0 (0.00)	1 (0.14)
Zygosaccharomyces spp.	21 (3.36)	1 (0.14)	4 (0.35)	2 (0.28)
Total	**625**	**715**	**1132**	**725**

* number of isolated strain; in brackets – percent of isolated strains
** NI – strains unidentified or uncertain affiliation

It is hard to believe the lack of sewage plants in Wolin and Nowe Warpno – namely the two towns nearest to the sampling sites or marine waters inflows discharging impurities from Świnoujście to be the cause of that phenomenon. A specificity of the Szczecin Lagoon environment can be the cause of the atipical presence of mycoflora representatives. There is no easy explanation for the high numbers of *Saccharomyces cerevisiae* strains at the WWE station. There is no (except for small fishing site Nowe Warpno) industrybeing a potential source of such contamination – in the neighbourhood.

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Analiza mikoflory wód Zalewu Szczecińskiego

Streszczenie

Wykonano badania ilościowe i jakościowe grzybów drożdżoidalnych występujących w wodach Zalewu Szczecińskiego. Stwierdzono, że dynamika zmian ilości drożdży tego estuarium jest typowa dla wód słonych i estuariów, w których maksymalna koncentracja grzybów drożdżoidalnych występuje zawsze w okresie letnim. Badania jakościowe wyizolowanych szczepów wykazały, że na trzech stacjach pomiarowych najczęściej występującym gatunkiem była *Rhodotorula glutinis* na czwartej zaś *Candida colicullosa*.