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Yeasts isolated from the lakes of Dhanmondi and Ramna, Bangladesh

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The occurrence of yeasts in the water of two lakes located in Dhaka City over a period from September to December 1999 was investigated. The number of yeasts of lake Dhanmondi and Ramna ranged from 9.5×10^4 to 35×10^4 and 2.3×10^4 to 11×10^4 CFU/l, respectively. The isolated yeast strains belonged to 5 species: *Saccharomyces cerevisiae, Rhodotorula glutinis, Rhodotorula mucilaginosa, Debaryomyces hansenii* var. *fabryi* and *Candida suecica*. The maximum number of yeasts was found to be 3 times higher in the water samples of Dhanmondi lake than that of Ramna lake. The higher number of yeasts was correlated with the temperature of the water and with pH values.

Key words: yeast community, occurrence, lake water, Bangladesh

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Študoval sa výskyt kvasiniek vo vode dvoch jazier v meste Dhaka v období od septembra do decembra 1999. Počet kvasiniek v jazere Dhanmondi sa pohyboval v rozmedzí $9,5\times10^4$ až 35×10^4 CFU/l a v jazere Ramna $2,3\times10^4$ až 11×10^4 CFU/l. Izolované kmene kvasiniek boli zaradené do 5 druhov: *Saccharomyces cerevisiae, Rhodotorula glutinis, Rhodotorula mucilaginosa, Debaryomyces hansenii* var. *fabryi a Candida succica*. Zistilo sa, že maximálny počet kvasiniek bol 3-krát vyšší vo vzorkách vody z jazera Dhanmondi než z jazera Ramna. Vyšší počet kvasiniek koreloval s vyššou teplotou vody a s pH hodnotami.

INTRODUCTION

Water is a natural habitat for many micro-organisms but few surveys have been conducted to estimate the numbers of yeasts in waters. The relation between the extent of water pollution and the yeast flora are not known both regarding numbers and varieties of yeasts. Simard and Blackwood (1971) reported yeasts isolated from water samples taken from five widely separated collection points on the St. Lawrence River. Although yeasts have been shown to be common inhabitants of water, yet it is important to determine the yeast populations of both polluted and relatively unpolluted waters (Spencer et al. 1974). Their number and species composition depend on the type and purity of water (Hagler and Mendonca-Hagler 1981).

Yeasts can enter the water with swimmers, fish, animals, plants and also with sewage. Yeasts were found in the water of three artificial freshwater lakes. The lakes were used for recreational purposes and situaed in the area of Lowland Záhorie of Slovakia (Sláviková et al. 1992).

The numbers and species of yeast occurring in lakes and streams might serve as an index of the amount of pollution in such waterbodies. The presence of yeasts in any numbers in water could be taken as an indication of the presence of sewage as well. The need for detection and determination of yeasts which are able to biodegrade and/or accumulate organic and inorganic toxicants has become greater as water pollution has increased (Kwasniewska 1988).

In Bangladesh, limnological studies of lake water were made from time to time (Islam et al. 1979; Khondker et al. 1988; Khondker and Parveen 1992, 1993). It was reported that Lake Dhanmondi was highly eutrophic to hypertrophic and also contaminated by sewage, garbage from nearby residential colonies, markets, dopes used by anglers, direct input of waste products from slum areas situated on the bank, and had a high concentration of O_2, N_2 and P too. On the other hand, Lake Ramna was free from those contaminants. However, isolation of yeasts from lake water was not attempted. The present study represents an initial investigation on the occurrence of yeasts in water of the two artificial lakes Dhanmondi and Ramna.

MATERIAL AND METHODS

Studysites

The lakes of Dhanmondi and Ramna are artificial lakes in the city of Dhaka, Bangladesh. They were selected for the present study and sampled from September to December 1999. Samples were taken from five different sites (widely separated) at each lake. Water was collected in sterile plastic bottles and transported to the laboratory on ice. Samples were processed within 2 hours after collection.

Methods

Ten-millilitre aliquots of water were precipitated with a colloidal solution containing 0.5 ml 10 % sodium carbonate and 0.25 ml 10 % ferric sulphate and centrifuged for 2 minutes. Three drops of 20 % sodium-potassium tartarate were added and the mixture were streaked on malt agar plates containing 100 μg/ml chloramphenicol (Sláviková et al. 1992).

The isolation of yeast was carried out with the serial dilution technique. Malt agar plates containing chloramphenicol were all used throughout of the study. The pH of the medium was adjusted to 6.81 and the plates incubated from 3 to 7 days at 22 °C. Colonies of different appearance were counted. A digital colony counter

was used for the purpose of yeast count. The density of yeasts was estimated by calculating the number of colony forming unites (CFU) per litre.

Morphological and physiological characteristics of isolates were examined by the methods described by Yarrow (1998). Isolates were identified according to Kurtzman and Fell (1998).

RESULTS AND DISCUSSION

Temperature, pH and yeast densities (CFU/l) are shown in the Table 1. The temperature of the water of Lake Dhanmondi ranged from 19.9 °C to 22.4 °C, in Lake Ramna from 20.0 °C to 23.5 °C. The pH of the water differed in the two lakes. The pH of the water from Lake Dhanmondi ranged from 5.99 to 8.50, in Lake Ramna from 6.01 to 7.75. The results revealed that the pH, temperature and yeast densities differed between the lakes. Yeast densities in Lake Dhanmondi ranged from 9.5×10^4 to 35.0×10^4 CFU/l, in Lake Ramna from 2.3×10^4 to 11.0×10^4 CFU/l. The highest yeast population density was observed in the water of Lake Dhanmondi. Higher numbers of yeasts were found at a temperature of 22.4 °C both in Lake Ramna and Lake Dhanmondi (Table 1).

Table 1. Temperature, pH and yeast densities of the lakes of Dhanmondi and Ramna.

Lake	Temperature (°C)	pH	Yeast densities CFU/l
Dhanmondi	19.9	5.99	9.5×10^4
	20.0	6.00	15×10^4
	21.0	6.02	28×10^4
	22.2	7.04	22×10^4
	22.4	8.50	35×10^4
Ramna	20.0	6.01	2.3×10^4
	21.1	6.50	3.5×10^4
	22.4	6.65	5.0×10^4
	23.5	6.85	7.1×10^4
	22.4	7.75	11.0×10^4

Simard and Blackwood (1971) published yeast densities in the St. Lawrence river during summer varying from 0 to 9500 per 100 ml. The yeast densities in water samples of the river Danube ranged from 100 to 21,100 CFU/l (Sláviková and Vadkertiová 1997). Sláviková et al. (1992) reported densities of *Aureobasidium pullulans* (black yeast) reaching about 5×10^3–10×10^3 cells per litre in some regions of Lake Jakubov.

The isolated 18 yeast strains belonged to 5 species. Out of these strains 7 represented the species *Saccharomyces cerevisiae* Meyen ex E. C. Hansen,

Table 2. Main characteristics of the isolates

Identified species	Isolate No.	Source	Colony colour	Cell measurement (μm)	Pseudo-mycelium	Urea hydrolysis	Fermentation of saccharides	Assimilation of KNO_3	Growth at 37°C
Saccharomyces cerevisiae	Y1, Y2, Y3	Ramna	Cream	(6.6–9.9) × (9.9–13.2)	Rudimentary	Negative	Positive	Negative	Positive
	Y4, Y6, Y12, 14	Dhan-mondi							
Rhodotorula glutinis	Y15	Ramna	Red	(3.5–5.0) × (5.0–6.6)	Absent	Positive	Negative	Positive	Positive
	Y8, 10c	Dhan-mondi							
Rhodotorula mucilaginosa	Y7, Y11	Ramna	Pink	(3.3–8.3) × (3.3–8.3)	Absent	Positive	Negative	Negative	Positive
	Y10r, Y17	Dhan-mondi							
Debaryomyces hansenii var. *fabryi*	Y16	Ramna	White	(3.3–7.4) × (3.3–9.9)	Present	Negative	Negative	Negative	Positive
	Y5	Dhan-mondi							
Candida suecica	Y13	Ramna	White	(3.3–6.6) × (6.6–12.0)	Present	Negative	Negative	Negative	Positive
	Y13	Ramna							
	Y9	Dhan-mondi							

3 strains belonged to the species *Rhodotorula glutinis* (Fresenius) F. C. Harrison, 4 strains to *Rhodotorula mucilaginosa* (Jörgensen) F. C. Harrison, 2 strains to *Debaryomyces hansenii* var. *fabryi* (Ota) Nakase et M. Suzuki and the remaining 2 strains were identified as *Candida suecica* Rodrigues de Miranda & Norkrans. These five different species varied in colour, cell size, urease activity, fermentation of saccharides and assimilation of nitrate (Table 2). The occurrence of these species could also be influenced by their ability to grow at higher temperatures. All isolated strains grew well at 37 °C.

In aquatic environments, that is rivers, ponds and lakes, representatives of the genera *Candida, Trichosporon, Rhodotorula, Hansenula, Cystofilobasidium,*

Geotrichum and *Saccharomyces* were isolated most frequently (Spencer et al. 1970, 1974; Simard and Blackwood 1971; Sláviková et al. 1992; Sláviková and Vadkertiová 1997).

The ascosporogenous yeast species *Saccharomyces cerevisiae* was the predominant species isolated from samples taken from both studied lakes. It was reported that *S. cerevisiae* was a stable constituent of the activated sludge biocenosis of different industrial waste waters (Grabinska-Loniewska et al. 1993). Spencer et al. (1974) isolated this species together with *Trichosporon cutaneum* as a dominant species in a domestic sewage treatment plant; it was often found in river and fish pond water, too (Spencer et al. 1970; Sláviková and Vadkertiová 1995, 1997). *S. cerevisiae* is able to ferment saccharides. The incidence of fermentative yeasts in the environment are reported characteristic for sewage (Hagler et al. 1981).

Carotenoids producing red and pink yeasts were also isolated very frequently from both lakes. During periods of bright sunlight, carotenoids protect the vital structures and processes of yeast cells and this is a possible reason for the predominance of red yeasts in the upper layers of water (Kwasniewska 1988). All isolated strains belonged to the basidiomycetous species *Rhodotorula glutinis* and *R. mucilaginosa* (Table 2). Species of the genus *Rhodotorula* have also been observed in Lake St. Clair (Kwasniewska 1988) and pink yeast isolates were collected from the St. Lawrence River (Simard and Blackwood 1971). Higher densities of red yeasts were found in surface water layers, where phenolic contaminants and petrochemicals in higher concentration were discharged (Kwasniewska 1988).

The black yeast *Aureobasidium pullulans* was often isolated from artificial lake waters (Sláviková et al. 1992). No black yeasts were found in Dhanmondi and Rhamna lakes but the white yeasts *Debaryomyces hansenii* var. *fabryi* and *Candida suecica* were found during this study (Table 2).

In this study the main representatives of the yeast population were found to be similar in both two lakes. The highest densities were observed in Dhanmondi Lake into which organic waste, domestic, industrial, sewage and residential waste are discharged. In Lake Ramna only human activity takes place. Therefore the densities of yeast populations were relatively low in Lake Ramna.

The studied water environment probably positively affects the presence of yeast species by metabolic activities within compounds of natural and industrial origin and could be one of the reason for their dominance there. This suggests that they may play an important role in the aquatic environment of lakes. Much more study will be necessary to provide a reasonable explanation for the presence of yeast populations and their possible interaction with the environment.

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