*Current Topics in Biophysics* 2007, 30, 19-21

# TRANSMISSION SPECTRA OF YEASTS

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Received January, 18, 2007; accepted October 30, 2007; published online November 10, 2007

**Transmission spectra of two species of yeast on glass or sapphire substrates were studied in detail. The most intensive interactions with the radiation takes place in the near ultraviolet region. Thus, it is found in naturally degraded samples and it is related to the change in the DNA.**

## INTRODUCTION

Optical spectroscopy of organic compounds is of great importance in determining energy levels of molecules and complexes which make these compositions [Brajtburg et al. (1989), Imamura et al. (1988), Ito and Kobayashi (1975)]. This study was aimed at experimentally measured transmission spectra of yeasts deposited on glass or sapphire substrates.

## EXPERIMENTAL PART
## DISCUSSION OF RESULTS

Measurements were carried out at room temperature in the range of wave length of $\lambda$ = 200÷ 1100 nm in the two-beam spectrometer of SPECORD type with computer data processing. Two species of yeasts were studied *Saccharomyces* and *Pichia* [Brajtburg et al. (1989)]. Both test samples and those irradiated by $\gamma$-$Co^{60}$ were exposed to the dose 40 000 Gy. Thin films (of thickness 0,1 – 0.3 mm) were deposited [Murasugi and Tohma-Aiba (2003)] by the even layer. Films of the aluminium oxide ($Al_2O_3$) transparent in the visible and near ultraviolet region of spectrum were used. The spectra were measured at room temperature (~ 300 K). The curves of T % vs. $\lambda$ dependences are presented in semilogarithmic coordinates (Fig. 1, Fig. 2), since in most cases absorption phenomena of absorption of light of the intensity $I_0$ in the medium of thickness x with the coefficient of absorption $\alpha$ are described by exponential laws [Imamura et al. (1988)]

$$I(x) = I_0 \exp(-\alpha x) \ .$$

Transmission spectra are almost transparent in the red and near-infra-red regions of spectrum. It is known [Ito and Kobayashi (1975)] that the maximal absorption of the DNA takes place at a wave-length of about 260 nm. In violet and ultraviolet regions there is considerable absorption of electromagnetic radiation, especially in case of *Pichia*. In this species a sharp band of absorption in the region of 200-300 *nm* is observed below 200 *nm* transmission coefficients reach identical values.

It is possible to assume for a model that the minimum transmission band at wave-length $\lambda$ with photon energy of about 5 *eV* (taking into account $E_f = hc/\lambda$ where h is the Plank constant, c is speed of light) takes place due to the break of chemical bonds with tearing off electrons, especially C-H. It is the dependence of transmission coefficient on the thickness of layer that indicates (Fig. 3), that intensive interaction with radiation takes place exactly in the near ultraviolet region. Since there is the effect of degradation, for 16 days absorption rises and there takes place the change of chemical bonds. Thus in naturally degraded samples additional absorption peaks can be observed at wave-length $\lambda$ = 260 *nm* and it is related to the change in the DNA [Tryon et al. (1979), Mehra and Winge (1988)]. Probably it takes place due to oxidizing processes with participation of oxygen. On the contrary, in the yeasts exposed to the rays $\gamma$- $Co^{60}$ at the dose 40 000 *Gy* after irradiation light absorption slightly decreases (Fig. 4). It can be connected with the reduction of activity of unadopted cells under the influence of radiation (the phenomenon of radiation denaturation).

## CONCLUSIONS

Transmission spectra of two species of yeasts of *Saccharomyces* and *Pichia* are almost transparent in red and near-infra-red regions of spectrum. A sharp band of absorption in the region of 200-300 *nm* takes place due to the break of chemical bonds C-H with tearing off electrons. The most intensive interaction with radiation takes place exactly in the near ultraviolet region. Thus in naturally degraded samples in the spectrum additional absorption peaks can be observed related to the change in the DNA. Probably it is a result to oxidizing processes with participation of oxygen. On the contrary, in the irradiated yeasts after radiation light absorption slightly decreases. It can be related to the reduction of activity of unadopted cells under the influence of radiation.

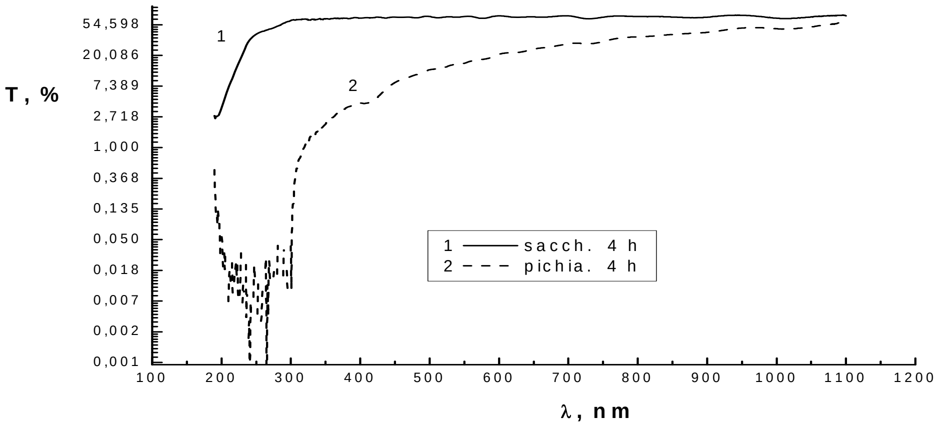


Fig. 1. Spectral dependence of transmission coefficient of yeasts after 4 hours after preparation. (1) stands for *Saccharomyces* and (2) for *Pichia*.

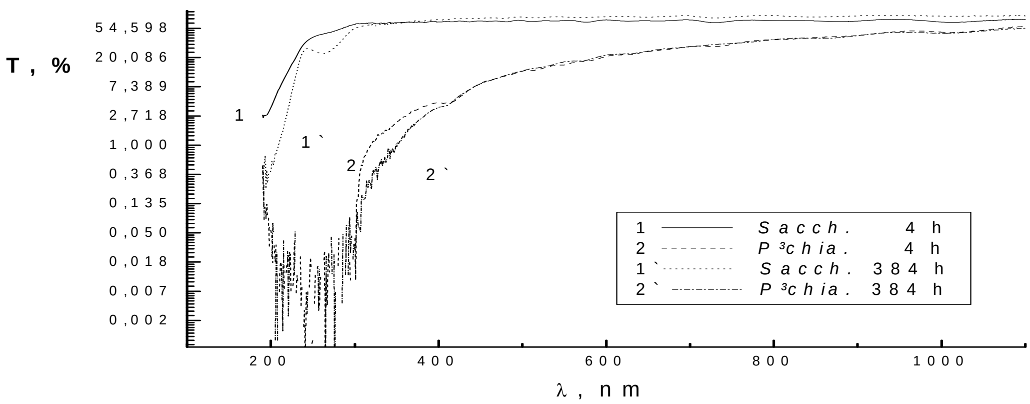


Fig. 2. Changes of transmission coefficient of yeasts *Saccharomyces* and - *Pichia* after 4 hours after preparation and after 384 hours after preparation.

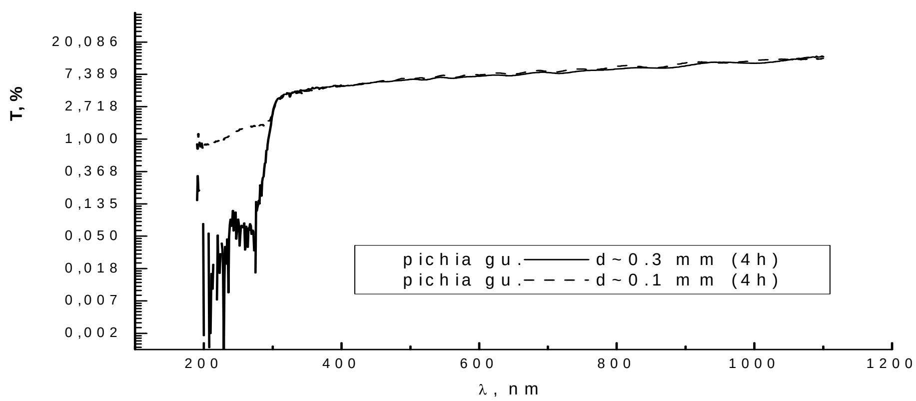


Fig. 3. Spectral dependence of transmission coefficient of the yeasts of *Pichia* of different thicknesses: 0,3 mm and 0,1 mm.

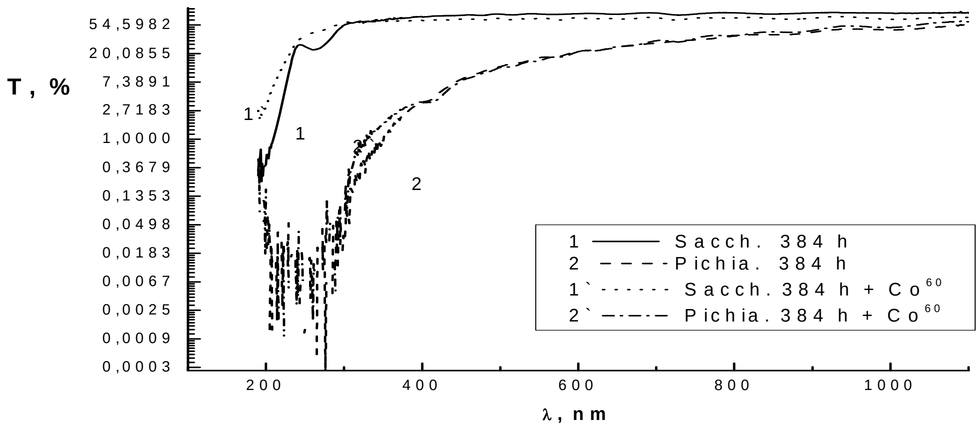


Fig. 4. Changes of transmission coefficient of yeasts under the influence of gamma radiation $Co^{60}$: *Saccharomyces* and *Pichia* - natural degradation after 384 hours and accordingly degradation under the influence of gamma radiation $Co^{60}$.

REFERENCES


Brajtburg J, Gruda I, Daigle I, Medoff G. Concentration dependent dual effect of the monolauryl ester of sucrose on the antifungal activity and absorption spectra of amphotericin B (Fungizone) // Biochimica et Biophysica Acta (BBA) - Biomembranes, V. 985, Iss. 3, 1989, pp. 307-312.

Imamura T, Sugahara K, Adachi S, Miyatsu Y, Mizokami H, Matsusaka T. Purification and characterization of the hepatitis B virus core antigen produced in the yeast Saccharomyces cerevisiae// Journal of Biotechnology, V. 8, Iss. 2, 1988, pp. 149-161

Ito T, Kobayashi K. Studies of the induction of mitotic gene conversion by ultraviolet irradiation : II. Action spectra Mutation Research // Fundamental and Molecular Mechanisms of Mutagenesis, V. 30, Iss. 1, 1975, pp. 43-53.

Mehra RK, Winge DR. Cu(I) binding to the Schizosaccharomyces pombe γ-glutamyl peptides varying in chain lengths // Archives of Biochemistry and Biophysics, V. 265, Iss. 2, 1988, pp. 381-389.

Murasugi A, Tohma-Aiba Y. Production of native recombinant human midkine in the yeast Pichia pastoris // Protein Expression and Purification, V. 27, Iss. 2, 2003, pp. 244-252.

Tryon E, Cress M C, Hamada M, Kuby S A, Studies on NADPH-cytochrome c reductase I: Isolation and several properties of the crystalline enzyme from ale yeast // Archives of Biochemistry and Biophysics, V. 197, Iss. 1, 1979, pp. 104-118.