VOLUME-6 | ISSUE-4 | APRIL - 2017 • ISSN No 2277 - 8179 | IF : 4.176 | IC Value : 78.46

THE RESEARCH OF SHORT MICROWAVE RADIATION ON BIOCHEMICAL ACTIVITY OF SACCHAROMYCES CEREVISIAE YEAST CULTURE

Biotechnology

KEYWORDS: microwave radiation, yeast, *Saccharomyces cerevisiae*

Ananyeva E.P. Federal State Budgetary Educational Institution of Higher Education "Saint-Petersburg State Chemical-Pharmaceutical Academy" of Ministry of Health of Russian Federation

Sigareva L.P. Federal State Budgetary Educational Institution of Higher Education "Saint-Petersburg State Chemical-Pharmaceutical Academy" of Ministry of Health of Russian Federation

Ivanov V.A. Federal State Autonomic Educational Institution of Higher Education "Saint-Petersburg State Electrotechnical University named after V.I. Ulianov (Lenin)"

ABSTRACT

Saccharomyces cerevisiae yeast culture was exposed to microwave radiation of low specific absorption with the view of identifying possible effect of given range of microwave radiation on cells growth and biochemical activity. Yeast cultivation was carried out in fluid growth medium for 48 hours in dynamic conditions. Control and treated samples were studied by the following characteristics: total cell concentration, the amount of living cells in culture broth and biochemical activity. It was determined that the concentration of treated yeast cell on the 2nd day was 1,8 times higher than the concentration of control yeast cells, in addition to that increase of treated culture viability was noted. Thus, possibility of stimulating *Saccharomyces cerevisiae* yeast culture growth and biochemical activity with microwave radiation treatment was shown.

INTRODUCTION

Microwave radiation is successfully used for treatment of various natural materials (molasses, plant raw materials, excipients) [1]. However, when treating materials in limited sublethal range of microwave radiation (power density must be LA 0,2 W/kg) stimulating effect on microorganism cells growth rate was detected [2,3]. This particular effect can be of interest in stimulating of *Saccharomyces cerevisiae* yeast culture growth rate, production strains included, while industrial cultivating of yeast culture.

AIMS AND OBJECTIVES

The aim of this investigation was the research into the effect of microwave radiation of low power density on *Saccharomyces cerevisiae* yeast culture, detection of radiation parameters that stimulate culture growth. With this aim the following assigned tasks were assigned: investigation of the effect of microwave radiation of explicit range on the cell biomass amount, investigation of cell viability in various explicit treatment conditions, matching of optimum process conditions in which maximal effect is reached.

MATERIALS AND METHODS

Saccharomyces cerevisiae yeast culture was used as a starting material. Saccharomyces cerevisiae yeast culture suspension in sterile saline with concentration 7,0·106 CFU/ml was used for experiments. 5,00±0,01 ml of this suspension was aseptically loaded in each sterile tube, microwave radiation treatment was held with the following parameters: microwave radiation operating frequency 2450 MHz, 1 operating magnetron, radiating power of one magnetron 600 W [4]. Final temperature of control sample and treated samples was measured with infrared pyrometer. After treatment 1 ml of cell suspension from each tube was taken and placed in cultivation flasks with 25 ml of sterile fluid Sabouraud growth medium. Yeast cells were cultivated for 48 hours in Sartorius Stedim CERTOMAT® CTplus bioreactor [5] in dynamic conditions (rotating speed 100 rpm), cultivating temperature 23,0±0,1 °C. Cell concentration in culture broth was estimated directly by scoring in count chamber [6], cell viability was estimated by the oxidation level of glucose. Oxidation level of glucose was estimated indirectly by alteration of pH of glucose solutions when adding yeast culture in certain periods of time for 360 seconds [7]. Percentage of viable cells was determined by cells count with methylene blue stain [7].

Power density of microwave radiation absorbed by samples was determined after treatment.

Experimentally obtained data was statistically treated with the use of Student's test [8].

RESULTS AND DISCUSSION

Yeast samples' treatment was held in temperature range from 27,1±0,1 to 34,3±0,1 °C with constant magnetron operating power 600 W. Magnetron operating time had the range from 5 to 8 s (*Table 1*).

Table 1: Yeast samples treatment parameters

Treatment modes	Heating temperature, °C	Magnetron operating power, W	Treatment time, s	Power density, P_i/m, W/g
Control (no treatment)	22,1±0,1	-	-	-
1	27,1±0,1	600	5	4,2±0,1
2	29,2±0,1		6	4,9±0,1
3	31,0±0,1		7	5,3±0,1
4	34,3±0,1		8	6,4±0,1

It was determined that treated sample temperature depended in direct proportion on treatment duration and power density of microwave radiation *(Table 1)*. Temperature rose fast and evenly through the whole treated sample volume.

Yeast culture concentration and percentage of viable cells in culture broth were fixed on the 2nd day of cultivation.

Table 2: *Saccharomyces cerevisiae* yeast culture concentration and percentage of viable cells

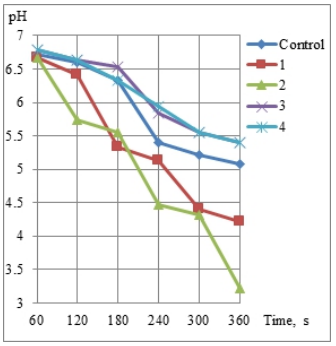
Treatment modes	Yeast concentration, CFU/ml	Percentage of viable cells, %
Control (no treatment)	$1340 \cdot 10^6$	64,3±0,1
1	$2014 \cdot 10^6$	72,2±0,1
2	$4267 \cdot 10^6$	75,8±0,1
3	$2101 \cdot 10^6$	62,1±0,1
4	$1392 \cdot 10^6$	54,9±0,1

Note: CFU/ml – colony forming units per 1 ml of culture broth

It was shown that mode 2 was the most effective treatment mode, which showed that yeast concentration was 3,2 times higher than in control sample and percentage of viable cells was maximal in comparison with other treatment modes (*Table 2*). Viable cells amount in terms of CFU was 3,8 times higher than in control sample. Biochemical activity of yeast culture was detected by the ability to

utilize glucose, intensity of pH alteration was evaluated. Start pH value of glucose solution was 6,82.

Figure 1: Biochemical activity of *Saccharomyces cerevisiae* yeast culture



Yeast culture treated in mode 2 showed the largest biochemical activity: by the time 360 s pH value of glucose solution decreased to 3,21. Other treatment modes did not show such dramatically decreased pH (*fig. 1*). Thereby, mode 2 has been shown as the most effective of studied modes.

CONCLUSION

1. Stimulating effect of microwave radiation of low power density on Saccharomyces cerevisiae yeast culture and explicit treatment parameters (treatment time from 5 to 8 s, magnetron operating power 600 W, temperature range from 27,1±0,1 to 34,3±0,1 °C) was investigated.

2. It was shown that maximal yeast biomass increase (3,2 times), increased amount of viable cells (3,8 times) and maximal biochemical activity was observed in the treatment with the following parameters: microwave radiation operating frequency 2450 MHz, 1 operating magnetron, radiating power of one magnetron 600 W, heating temperature 29,2±0,1 °C, treatment time 6 s, power density 4,9±0,1 W/g. This particular treatment mode can be used for yeast culture treatment with the view of stimulating the biomass growth.

REFERENCES:

1. Sigareva, L.P., Ananyeva, E.P., Ozhigova, M.G., Ivanov, V.A., Mironov, D.V. (2016). Microwave radiation effects on microbial contaminants in the raw materials of botanical origin. The scientific-applied journal Pharmacy, 6(65), pp. 49-52. (In Russian)
2. Kuznecov, D.B. (2013). Physico-chemical mechanisms to infrared of radiation on microorganisms. Scientific journal Fundamental research, 4(2), pp. 414-418. (In Russian)
3. Kuznecov, D.B. (2013). Physico-chemical mechanisms to extremely high frequency of radiation on microorganisms. Scientific journal Fundamental research. [Electronic resource]. – Electronic data. – Date accessed: 12.01.2016. – Access: https://www.science-education.ru/ru/article/view?id=8226. (In Russian)
4. Ivanov, V.A. Patent for useful model, №: 46567, Russia, IPC: F26B, 2007. (In Russian)
5. Sartorius Stedim CERTOMAT® CTplus Specifications. [Electronic resource]. – Electronic data. – Date accessed: 12.01.2016. – Access: http://microsite.sartorius.com/fileadmin/sartorius_pdf/alle/biotech/Data_Certomat_CTplus_SL-2059-e.pdf – The title screen. (In English)
6. State Pharmacopoeia of the Russian Federation of the XIII ed., Vol. 1 [Electronic resource]. – Electronic data. – Date accessed: 28.12.2015. – Access: http://193.232.7.120/feml/clinical_ref/pharmacopoeia_1/HTML/#849/z – The title screen. (In Russian)
7. Messing, N., Metz H. (2013) Hefen und Bakterien stärken unsere Gesundheit: Mikro-Organismen als Wirkstoff-Produzenten und Veredler von Lebensmitteln. Verlag Ganzheitliche Gesundheit, p. 150. (In German)
8. Lincoln E. Moses. (1986) Think and Explain with statistics. Addison-Wesley, p. 483. (In English)