OP-4

Yeast response to hyperbaric stress

ISABEL BELO, RITA PINHEIRO, MANUEL MOTA

Centro de Engenharia Biológica, Universidade do Minho, Campus de Gualtar, 4710-057 Braga Codex, Portugal, Tel. +351253604400, fax: +351253678986, email: ibelo@deb.uminho.pt

Yeasts are subjected to many types of stress throughout fermentation process (e.g. pressure and oxidative stress). Knowledge on the impact of these stress factors and their lethal limits is crucial to establish and control operating conditions. In yeast cultivation, total pressure is an important stress factor, largely because it changes the partial pressure of dissolved gases, in particular dissolved oxygen and carbon dioxide concentrations. In industrial bioreactors of several tens meters high, pressure and gas solubility are function of the local position in the bioreactor, generally increasing by 1 bar for every 10 m increase in depth. However, laboratory research is usually performed at atmospheric pressure. Hyperbaric bioreactors have been used to investigate the behaviour of yeasts to the increase of pressure. The results obtained with different yeasts (*Saccharomyces cerevisiae, Kluyveromyces marxianus* and *Candida utilis)* will be presented and discussed. Yeasts were cultivated in stainless steel bioreactors fed with compressed gas. The effects of pressure, to a maximum of 1.5 MPa, were analysed for different pure gases and mixtures to discriminate the effects of pressure and the effects of gas nature. Air, pure oxygen, nitrogen, carbon dioxide and mixtures were used to cover aerobic and anaerobic processes. Besides metabolic and oxidative stress cell response to pressure, morphological changes were assessed by novel image analysis procedures. The effects of gas pressure rise on yeast strongly depended on the nature of gas, strain, mode of operation, medium composition, etc. Hyperbaric air to a maximum of 1.0 MPa, showed to be useful to enhance oxygen mass transfer from gas phase to the medium, especially in fed-batch cultures of *S. cerevisiae* and in batch cultures of *C. utilis* and *K. marxianus.* Generally, anti-oxidant enzymes were induced by air and oxygen pressure, but their response depended on the physiological state of the cell. The pre-adaptation of cells to hyperbaric air increased yeast resistance to chemical oxidants. Inhibition of cell activity by hyperbaric pressure was found for pure oxygen and carbon dioxide. The toxicity of these gases cause cell viability loss, inhibition of cell reproduction and cell size decrease.