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Application of hyperbaric bioreactors for bioprocess development

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For many years pressure was disregarded by biotechnologists when considering processes based on microbial cultures, due to the idea of incompatibility of life in pressure environments above atmospheric pressure. However, the discovery of microbial life in such environments has refuted this idea. Moreover, in industrial bioreactors microorganisms are exposed to spatial gradients of pressure (with average values above atmospheric pressure), since its value is a function of liquid height. Consequently, local differences of gas solubility occur in industrial bioreactors. This can have a strong impact on overall productivities, namely on bioreactor scale-up. Thus, simulations of these conditions in lab-scale reactors working at wide-ranging total pressure are of great importance.

On the other hand, the use of hyperbaric bioreactors (working with total gas pressure of several units or tens above atmospheric pressure), can be applied for oxygen transfer rate improvement for aerobic microbial cultures [1]. In fact, the oxygen demand in high cell density cultivation exceeds by far the maximum oxygen transfer capacity of conventional bioreactors such as stirred tanks or bubble columns.

Our group has been studying the effects of increase air pressure on microbial physiology in order to assess the limits of its use for oxygen unlimited cellular growth.

This work is focused on the application of hyperbaric bioreactors for the cultivation of different yeast species of industrial interest, such as *Yarrowia lipolytica* and *Pichia pastoris.* Besides cellular growth enhancement by oxygen solubility increase, also effects on enzymes activities were found, either of metabolic pathways, oxidative stress cellular response mechanism and extracellular enzymes.

References:

[1] Lopes M, Gomes N, Mota M, Belo I, "*Yarrowia lipolytica* growth under increased air pressure: influence on enzymes production", Appl. Biochem. Biotechnol. (2009) 159(1): 46-53.