



EFFECT OF OXYGEN TRANSFER ON L(+) LACTIC ACID PRODUCTION BY *Rhizopus oryzae* NRRL 395 IN A STIRRED TANK REACTOR

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Introduction. Lactic acid is an organic compound that has been used for a long time in several industries such as food, textile chemical and pharmaceutical. It has been found that the fungus *Rhizopus oryzae* is able to produce this metabolite in an efficient way by aerobic metabolism [1]. To the best of our knowledge, there are not many studies that quantify the Oxygen Transfer Rate (OTR) in stirred tank bioreactors and its relation to the Oxygen Uptake Rate (OUR) during the lactic acid production.

Considering what is mentioned above, this work has been aimed to evaluate the effect of different oxygen transfer conditions on L(+) lactic acid production by *Rhizopus oryzae* NRRL 395 in a stirred tank bioreactor and its relationship with OUR by using dimensionless modified Damkohler number (Da) analysis.

Methods. A stirred tank bioreactor, operated at different stirring conditions, has been used to set maximum OTR (OTR_{max}) levels corresponding to 0.13, 0.28 y $0.79 \text{ kgm}^{-3}\text{h}^{-1}$. The OTR effect on the cell growth, sucrose consumption and L(+) lactic acid production during 96 hours of fermentation, have been evaluated. The measurements of OTR and OUR have been made using the dynamic method. Under these conditions, Da number was calculated to evaluate whether the process was limited by oxygen consumption biochemical reaction ($Da < 1$) or by mass transfer ($Da > 1$) [2].

$$Da = \frac{OUR_{max}}{OTR_{max}}$$

Results. Table 1 shows the values of lactic acid concentration, productivity and product yield after 96 hours of fermentation under the different OTR_{max} evaluated. The best results were obtained at the lowest value of OTR_{max} , and the production of lactic acid obtained was higher than other reported so far using sucrose as carbon source [3].

Table 1. Results of *Rhizopus oryzae* NRRL 395 fermentation under different OTR conditions.

	$OTR_{max} (\text{kgm}^{-3}\text{h}^{-1})$		
	0.13	0.28	0.79
Lactic acid (gL^{-1})	62.62	33.71	27.97
Productivity ($\text{gL}^{-1}\text{h}^{-1}$)	0.75	0.40	0.33
Yps (gg^{-1})	1.07	0.53	0.55

Da analysis allowed identifying that lactic acid production is limited by oxygen uptake rate. The highest production was achieved when $Da \cong 1$; in other words, when the OTR is similar to OUR by *Rhizopus oryzae*.

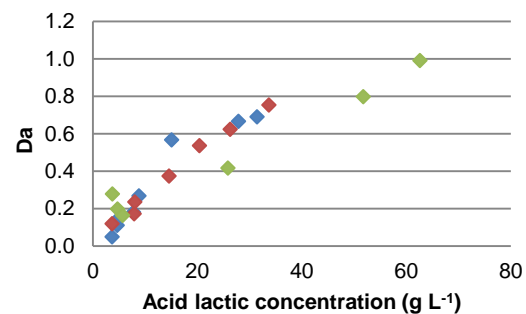


Fig.1 Relationship between Damkolher number and acid lactic production by *R. oryzae* NRRL 395. (♦) 0.13; (♦) 0.28 y (♦) $0.79 \text{ kgm}^{-3}\text{h}^{-1}$

Conclusions. Lactic acid increased with $Da \cong 1$, corresponding to conditions of $OTR_{max} 0.13 \text{ kgm}^{-3}\text{h}^{-1}$. This is, when mass transport resistance is similar to oxygen consumption biochemical reaction rate. The efficiency of lactic acid production was found to be a strong function of Da.

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