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Effect of some abiotic factors on the biological activity of *Gluconacetobacter diazotrophicus*

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ABSTRACT

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Aims: The effect of some abiotic factors, dryness, heat and salinity on the growth and biological activity of *Gluconacetobacter diazotrophicus*, and the influence of a salt stress on some enzymes involved in carbon metabolism of these bacteria is studied under laboratory conditions.

Methods and Results: Strain PAL-5 of *G. diazotrophicus* was incubated under different conditions of drying, heat and salinity. Cells showed tolerance to heat treatments and salt concentrations, and sensitivity to drying conditions. Higher NaCl dosage of 150 and 200 mmol l^{-1} limited its growth and drastically affected the nitrogenase activity and the enzymes glucose dehydrogenase, alcohol dehydrogenase, fumarase, isocitrate dehydrogenase and malate dehydrogenase.

Conclusions: *Gluconacetobacter diazotrophicus*, despite its endophytic nature, tolerated heat treatments and salinity stress, but its nitrogenase activity and carbon metabolism enzymes were affected by high NaCl dosage.

Significance and Impact of the Study: The investigation of the biological activity of *G. diazotrophicus* in response to different abiotic factors led to more knowledge of this endophyte and may help to clarify pathways involved in its transmission into the host plant.

Keywords: *Gluconacetobacter diazotrophicus*, abiotic factors, carbon metabolism, endophyte, enzymes, nitrogen fixation.

INTRODUCTION

Gluconacetobacter diazotrophicus is an obligatory aerobe capable of fixing atmospheric nitrogen (Attwood *et al.* 1991; Stephan *et al.* 1991; Alvarez and Martínez-Drets 1995). This bacterium is well adapted to extreme conditions such as high sugar concentrations and low pH (Stephan *et al.* 1991; James and Olivares 1997; Chanway 1998). Despite their capacity to survive in such extreme conditions, survival in soils, particularly in natural soils, is limited (Baldani *et al.* 1997).

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This endophyte possesses an active pentose-phosphate pathway, constituting the main operative pathway for the catabolism of glucose phosphate (Alvarez and Martínez-Drets 1995). The same authors detected a complete tricarboxylic acid cycle in this bacterium, and also respiratory chain-linked enzymes for the oxidation of glucose and keto-gluconates. Glucose dehydrogenase and cytocrome *ba* are the key components of the respiratory system of *G. diazotrophicus* during aerobic diazotrophy (Flores-Encarnación *et al.* 1999). Although it does not transport or metabolize sucrose *per se* (Alvarez and Martínez-Drets 1995), it grows on sucrose because of the extracellular saccharolytic enzyme activity that provides the bacteria with glucose or fructose for growth. In addition, *G. diazotrophicus* grows well on monosaccharides