

been selected for model studies of the system. The occurrence of this and the other versatile species, together with the lack of specialist autotrophs support the contention that experiments with pure cultures and simple mixtures of organisms can provide clues to the behaviour of considerably more complex systems.

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Aerobic denitrification and heterotrophic nitrification by *Thiosphaera pantotropha*

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Thiosphaera pantotropha (Robertson and Kuenen, 1983), a new species isolated from a denitrifying, sulphide-oxidizing wastewater treatment plant, is capable of active denitrification in the presence of substantial amounts of oxygen. This is contrary to current belief.

During studies on its denitrification system, *Thiosphaera pantotropha* was found to be capable of immediate denitrification after aerobic growth (Robertson and Kuenen, 1983). This suggested that the organism might have constitutive nitrate-reducing enzymes. Subsequent experiments using Kluver flasks to ensure thorough aeration, and incorporating an oxygen electrode, showed that with the dissolved oxygen at at least 80% of air saturation the cultures receiving nitrate grew faster than those without. They also gave a protein yield intermediate between those obtained with aerobic cultures lacking nitrate and anaerobic cultures provided with nitrate. A similar effect was observed when nitrite was used. Both the dissimilatory nitrate and nitrite reductases were present in cells grown on nitrate, but only nitrite reductase levels were significant in cells grown on nitrite or without a nitrogen oxide. Sufficient nitrate had disappeared from the culture to account for half of the acetate oxidized to CO₂. The remainder of the acetate must have been oxidized via oxygen.

During these experiments, nitrite was found in the acetate cultures not supplied with nitrate or nitrite. Even in cultures supplied with 5 mM nitrite, the nitrite level rose, reaching a peak just before the end of the logarithmic phase. After this, the nitrite concentration rapidly fell. This phenomenon, known as heterotrophic nitrification, may account for the nitrite reductase found in cells grown without a nitrogen oxide. Its physiological significance remains to be studied.

Aerobic denitrification would be of survival value in an environment where the ability to grow rapidly while denitrifying is important, but where limiting amounts of oxygen may be available.

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