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METABOLIC FLEXIBILITY OF A MICROBIAL SLUDGE AND AN AXENIC CULTURE

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Introduction. Metabolic flexibility usually has been linked to the metabolic capacity of a microorganism to consume different kinds of organic compounds (1) or to the change of the flux through a biochemistry pathway as a function of initial culture conditions (2). In this study *metabolic flexibility* was defined, as a metabolic capacity of a microbial sludge or axenic-culture to carry out more than one respiratory-process.
The aim of this work was to evaluate and to evidence the metabolic flexibility using axenic-culture isolated from microbial sludge in order to denitrify, metanize and sulfate-reducing.

Methods. A continuous stirred tank reactor (CSTR) was operated under denitrifying conditions. Microbial sludge was taken from CSTR in order to evaluate its metabolic capability to carry out the denitrification, methanogenesis and sulfate-reduction, in batch cultures. One strain was isolated from the microbial sludge, called "J", it was spiked in serological bottles in order to evaluate its metabolic flexibility to carry out the respiratory processes mentioned above. $C_2H_3O_2^-$ was used as carbon and energy source for all biological process, whereas the electron acceptors for denitrification and sulfate-reduction were NO_3^- and SO_4^{2-}, respectively. Microbial performance was evaluated in terms of consumption efficiency [E%, (mg of substrate consumed (NO_3^-, SO_4^{2-} or $C_2H_3O_2^-$)/mg substrate fed)*100)], production yield [Y_p, mg of product (N_2, HS^- or CH_4) /mg substrate consumed] and specific production rates [q, (mg of product/mg VSS d)].

Results. In the steady state of the CSTR the NO_3^- consumption efficiency was of 100%, with N_2 yield of 1. In batch cultures, microbial sludge showed metabolic flexibility to carry out three respiratory processes different among them. The kinetic and metabolic aspects were different for each biological process (Tab. 1). Experimental results showed quantitative evidences that the microbial sludge was able to carry out each biological process only with the imposition of some of the environmental culture conditions.

Table 1. Substrates consumption efficiencies, product yields and specific production rates of granular sludge

Process	E (%)	$Y_{p/s}$	q
Denitrifying	100±0.1	0.9±0.1	360.8±0.02
Methanogenic	100±0.01	0.1±0.01	37.9±0.62
Sulfate-reducing	49.1±1.4	0.4±0.1	5.3±0.36

The isolated strain showed metabolic capability to carry out denitrification and sulfate-reduction, since N_2 and HS^- were the end products, respectively (Tab. 2). CH_4 was formed at 1 day using the microbial sludge, on the other hand, axenic culture wasn't formed it for a period of 10 days, but a fraction of $C_2H_3O_2^-$ was consumed by unknown metabolic pathway. N_2 and HS^- specific production rates of granular sludge were lower than axenic culture. q, suggested that the respiratory process might be enhanced by the metabolic capability of a specific axenic-culture to carry out each process (3), and not by the association and cooperative of different microorganisms in the respective pathway.

Table 2. Substrates consumption efficiencies, product yields and specific production rates of the axenic culture

Process	E (%)	$Y_{p/s}$	q
Denitrifying	100±0.1	1.1±0.01	1959.5±8.7
Methanogenic	26.55±9.3	0.0	0.0
Sulfate-reducing	18.7±3.7	1.2±0.4	107.2±0.1

Conclusions. The microbial sludge showed metabolic capability to carry out denitrification, methanogenesis and sulfate-reduction. The strain J under axenic-culture conditions showed quantitative evidences of metabolic flexibility to denitrify and sulfate-reducing. No CH_4 formation was detected under the culture conditions here imposed.

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