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Organic carbon metabolism of haloalkaliphilic heterotrophs under alkaline and saline conditions – a potential role to treat alkaline and saline wastes

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The development of biotechnologies to treat bauxite residues of alkaline and saline nature would benefit from identifying functional haloalkaliphilic heterotrophs which are capable of metabolising organic carbon and tolerant strongly saline and alkaline conditions. Sources of haloalkaliphilic heterotrophs were extracted from biofilms thriving in the surface of seawater neutralised bauxite residues, which were cultured under glasshouse condition at 25 ℃ for 3 months. The present study aimed to evaluate initially the role of haloalkaliphilic and heterotrophic bacteria in organic carbon metabolism and associated neutralization effects under saline and alkaline conditions.

A laboratory incubation study with strongly saline and alkaline nutrient broth was conducted under anaerobic conditions, to investigate if the haloalkaliphilic and heterotrophic bacterial consortium extracted from the biofilms could metabolise carbohydrate and neutralize the alkaline pH under saline conditions. The haloalkaliphilic heterotrophs were subject to treatments of nutrient broth with seawater salinity and pH conditions of 8.5 to 10.8 buffered with 150mM carbonate. Cell optical density, culture pH and glucose concentration were monitored for 72 hours. It was found that the haloalkaliphilic heterotrophs neutralized culture pH by 0.5-1 unit in less than 24 hours. Cell growth and glucose consumption were strongly and positively correlated with the net pH reduction (i.e., neutralization efficacy). The glucose consumption rate was reduced at pH 10.8, together with decreased microbial growth, leading to halved (i.e., 50%) effectiveness in pH neutralization, compared to that with pH 8.5. The glucose metabolisms and pH reduction of these haloalkaliphilic heterotrophs were also regulated by available nutrients (e.g., N, P). Molecular characterization of the surviving and functional bacteria at different pH is underway. Further study will investigate the adaptation of haloalkaliphilic heterotrophs and organic carbon mechanisms, for identify specific functional genus and species which are tolerant of extremely alkaline and saline bauxite residues.