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Mineralization of "non-metabolizable" Glucose analogues in soil: Potential chemosensory mimics of Glucose

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Abstract

© 2017 Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim. Glucose is widely used to study the dynamics of easily available organics in soil. Pure culture studies have revealed that many microorganisms can sense and respond to glucose through chemosensory mechanisms that are not directly reliant on energy catabolism. However, the rapid mineralization of glucose by microorganisms makes it difficult to disentangle its energy effects from such non-catabolic interactions. "Non-metabolizable" glucose analogues have proven useful in mechanistic studies of glucose in pure culture, but have never been applied to complex microbial communities in soil. We sought to determine how their mineralization in soil differs from that of glucose, and whether they have potential as a new approach for investigating chemosensory mechanisms in soil microbiology. We incubated soil from an agricultural Haplic Luvisol under controlled conditions for 24 d and monitored CO 2 efflux after addition of (1) glucose, and three "non-metabolizable" glucose analogues: (2) 2-deoxyglucose (DG), (3) a-methylglucoside (aMG), and (4) 3-O-methyl-glucose (OMG), at three concentration levels, along with a control. All three analogues did in fact produce a large increase in soil CO 2 efflux, but the dynamics of their mineralization differed from the rapid degradation seen for glucose. At medium and high concentrations, CO 2 efflux peaked between 2.5 and 4 d after amendment with DG and aMG, and was delayed by about one week for OMG. The markedly different patterns of mineralization between glucose and OMG offer a new tool for investigating the behavior of glucose in soil. By using OMG as a glucose model, chemosensory mechanisms could be studied with limited interference from energy catabolism.

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Keywords

Carbohydrate, LMWOS, Microbial metabolism, Soil respiration, Soil sugars

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