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The fate of collembola derived organic matter in soil

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Soil collembola play an essential role in the initial comminution and degradation of organic matter entering the soil environment and yet the consequences of digestion for organic matter are poorly understood at the molecular level. Most soils contain millions of collembola faecal pellets per square metre and it is thought these are beneficial in releasing nutrients to plant roots as the faecal material is decomposed by microbes. However, despite its importance, very little is known about fate of collembola derived organic matter, i.e. collembola faeces, in the soil. The biochemical composition of organic matter processed by collembola and the faecal pellets produced were assessed and compared using a range of analytical techniques. 13C-labelled substrates were used to examine the differences in the decomposition process and determine the microbial community responsible for organic matter decomposition in soil microcosms.

The biochemical composition of collembola diets and the corresponding faeces were assessed and revealed a three-fold decrease in the concentration of n-alkanes, a four-fold decrease for n-alkanols and a ten-fold decrease for triacylglycerols and carbohydrates in the faeces relative to the diets. The decomposition of 13C-labelled substrates in soil was investigated, with analysis of the evolved CO2 showing the stabilisation of organic matter over the time scale of the experiment (80 days), with the amount of CO2 being evolved decreasing with time. The cumulative respiration of soil amended with collembola faeces was approximately four times lower than the soil amended with the parent diet. Changes in the composition and abundance of biopolymers in soil microcosms were investigated using pyrolysis-gas chromatography/mass spectrometry. An increase in abundance of guaiacyl components with carbonyl functional groups was observed in amended soil after incubation, indicating that lignin present after incubation was at a more advanced state of degradation. The concentration of carbohydrates was much lower after incubation, with all soils containing roughly the same concentration. The microbial community involved in the decomposition of organic matter was investigated by combining phospholipid fatty acid (PLFA) analysis with compound-specific stable carbon isotope analysis. The microbial biomass found in all incubated soils was of a similar size and was dominated by Gram-negative bacteria. An increase in concentration and δ13C value of 10-methylhexadecanoic acid in some of the amended soils reflects the important role of actinomycetes in lignin degradation, indicating that lignin transformations and/or wholesale degradation occurred within the timescale of the experiment.