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Transformations of ^{14}C lignin cell walls of wheat by a fungus and by bacteria from the rumen

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Monoaromatic compounds are degraded by the rumen microflora but little is known about the fate of lignins. The aim of this work was to study the transformation of ^{14}C lignins of wheat straw by ruminal bacteria and fungi.

Cell walls of wheat straw apical internodes specifically labelled on the syringyl methoxyl group using $O^{14}CH_3$ sinapic acid were used as substrates. They were incubated for 6 d with 3 cultures: a pure fungus *Neocallimastix frontalis*; a bacterial coculture *Syntrophococcus sucromutans*, which can demethylate monoaromatic rings (Doré and Bryant, 1990); and *Eubacterium oxidoreducens*, which transforms aromatic rings to non-aromatic products and a mixed culture of the fungi and the bacteria. In parallel a control substrate was incubated without microorganisms.

After fermentation the gases were trapped in NaOH solution and the dry matter disappearance (DMDis) was measured. Radioactivity was measured in solid, liquid and gaseous phases. Phenolic acids were analysed according to Scalbert *et al* (1985).

The control was not digested and only 5% of the radioactivity was solubilised.

A higher solubilisation of radioactivity of the solid phase than dry matter by fungi, suggested that these microorganisms were able to convert lignins (solubilisation and partial metabolism). Only traces of $^{14}CO_2$ were produced. Moreover fungi were able to hydrolyze more *p*-coumaric (PCA) than ferulic (FA) acids.

Bacteria degraded DM to a lesser extent than did fungi. The proportion of radioactivity solubilised was closer to the control. Nonetheless, a significant part appeared as $^{14}CO_2$. This demonstrates the ability of *S sucromutans* to demethoxylate lignins and, in the presence of the H_2-utilizing *E oxidoreducens*, to oxidize a methyl intermediate to CO_2. Furthermore, the bacterial coculture hydrolysed PCA and FA to the same extent.

The effect of the mixed culture on DMDis and on radioactivity solubilisation was comparable to the fungi alone, but the demethylation seemed reduced. FA was more hydrolysed than PCA.

In conclusion, our experiment suggests that fungi and bacteria have a hydrolytic action on cell-wall phenolics. The microorganisms studied have different mechanisms of attack. Bacteria mainly *O*-demethoxylate the monomers of lignins while fungi solubilise and perhaps 'convert' phenolic acids.

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Table I. Fate of ^{14}C-labelled lignins during anaerobic degradation.

Microorganisms	*DMDis*	*PCADis*	*FADis*	*RALiq* *	*$^{14}CO_2$* *
Fungi	30.7	43.5	25.6	45	Traces
Bacteria	9.3	30.4	30.8	3.2	0.13
Mixed culture	27.2	50.0	71.8	38.0	0.04

* % of initial radioactivity of the substrate.