FERMENTATION OF FLAVONOLS BY RUMEN ORGANISMS

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Forage plant phenolics with no tanning activity, although usually of low mammalian toxicity, are generally regarded as antinutrients (Harborne 1991). However some are degraded in the ruminant digestive tract and the “A” ring of flavonoids (Figure 1), being derived from acetate in biosynthesis, may in principle yield acetate. This has been shown to occur in vitro on prolonged incubation of quercetin with Eubacterium oxidoreductans (Krumholz and Bryant 1986). Here we investigate the fate of 3 flavonoids when incubated with a mixed rumen inoculum under conditions that simulate rumen fermentation.

This experiment employed in vitro gas pressure system in use for determining the rate of fermentation of fibrous substrates (Pell and Schofield 1993), in which we replaced the plant material with the pure compound being tested (sample size 25 mg instead of 100 mg). Rumen fluid came from a sheep on a Rhodes grass-lucerne diet. Compounds tested were quercetin, its 3-rhamnoglucoside rutin (Figure 1), and catechin which differs from quercetin only in the oxidation of the “C” ring. Gas pressures were monitored during incubation and VFA levels were measured in the medium at the end of the experiment. Corrections were applied using blank incubations with rumen fluid and medium only.

Quercetin and rutin were rapidly fermented with most gas production occurring within 30 hours (Figure 2). At the end of incubation there was a net yield of 1.65 moles of acetate per mole of quercetin, with other VFAs negligible. Rutin yielded 3.5 mole of acetate and 1.0 mole of propionate, the latter presumably coming from the sugar residues and confirming the origin of the acetate from quercetin. Catechin, despite its close structural relationship, was not fermented and was clearly inhibitory towards this inoculum.


Figure 1. Quercetin, R=H; Rutin, R= rhamnoglucoce

Figure 2. Progress of fermentation for quercetin and rutin

Fermentation of rutin is not so surprising because it is soluble and contains a disaccharide residue. However it was extremely surprising that the insoluble, fully phenolic aglycone, quercetin, could be fermented so rapidly by a mixed rumen inoculum. The rate of acetate production means that, in vivo, it could be absorbed from the rumen. Flavonol glycosides frequently occur at 1-5% of the DM in forage legumes and at much higher levels in tree leaves and some tropical plants. These results show they can contribute positively to ruminant energy metabolism and (depending on the metabolic cost of excreting the remaining phenylacetic acid residue) may even be regarded as nutrients. This has obvious implications for the utilisation of tropical forages.


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