HIGH VISCOSITY METHYLCELLULOSE LOWERS BLOOD GLUCOSE INDEPENDENTLY OF VOLATILE FATTY ACID PRODUCTION IN THE RAT

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Viscous plant fibres such as guar and oat gum effectively lower plasma lipids and assist in the control of blood glucose in man. These effects may be due either to inhibition of absorption caused by the high viscosity of the digesta in the upper gut (Sidhu & Oakenfull 1984) or to metabolic effects resulting from the production of volatile fatty acid by microbial fermentation of the fibre in the large bowel (Chen et al. 1984). To determine which of these two mechanisms operates in vivo we have fed rats diets containing methyl celluloses of low (25 cP), medium (400 cP) or high (1500 cP) viscosity. This fibre was chosen to minimise the confounding effects on microbial fermentation. Confirming that little or no fermentation was occurring, VFA concentrations in both caecal digesta and hepatic portal venous plasma were equally low with all three diets. Concentrations of propionate and butyrate were both particularly depressed, being <0.1 µmol/ml in the portal blood. Plasma triacylglycerols and cholesterol were unaffected by fibre viscosity but arterial blood glucose was significantly raised with the low viscosity methyl cellulose. Mean arterial and hepatic portal venous glucose were 9.2 ± 0.4 (5) and 7.3 ± 0.4 µmol/ml, respectively, compared with 7.3 ± 0.3 (5) and 6.7 ± 0.2 (5) µmol/ml in rats fed the 400 cP methylcellulose. The corresponding values in animals given the 1500 cP fibre were 7.8 ± 0.4 and 7.3 ± 4 µmol/ml. Liver glycogen was lowest in rats fed the 25 cP methylcellulose (mean value 91.1 ± 21.1 (5) µmol/g), intermediate with the medium viscosity diet (118.3 ± 17.4 (4) µmol/g) and highest with the 1500 cP fibre (129.7 ± 15.6 (5) µmol/g). In confirmation that these changes reflected the differences in fibre viscosity, the viscosity of caecal contents were 12 cP, 360 cP and 550 cP, respectively (at zero rate of shear).

It seems that the viscous dietary fibre can affect blood glucose control and hepatic glycogen content independently of the production of VFA by large bowel microbial fermentation. These data support the view that propionate and butyrate are not directly involved in the changes in plasma glucose in response to plant fibre polysaccharides (Illman & Topping 1986).

CHEN, W.-J.L. and ANDERSON, J.W. (1979). Am. J. Clin. Nutr. 57: 5678.
TOPPING, D.L. and ILLMAN, R.J. (1986). Med. J. Aust. 144: 307.
SIDHU, G.S. and OAKENFULL, D.G. (1984). Nutr. Rept Internat. 87 1234.

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