

Energy metabolism in pig colonocytes after adaptation to a high fibre diet.

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Energy metabolism in the colon has been poorly investigated. Feeding highly fermentable carbohydrates in the diet leads to an increased short chain fatty acid production in the colon, the effect of which on colonic mucosal metabolism is essentially unknown. The aim of the present study was to identify fuel substrates in colonic epithelial cells isolated from pigs adapted to a high vs low fibre diet.

For 4 wk post-weaning, 24 piglets were fed a low fibre diet (4% purified cellulose). Then 12 animals were fed the same diet for the following 5 wk, whereas the other 12 received a diet enriched in sugar beet fibre (12%). Colonocytes were isolated from the proximal colon using a method involving EDTA (10 mM), followed by hyaluronidase dissociation buffer (0.8%). The cell preparation was viable for 60 min at least, based on a linear metabolisation of U¹⁴C-glucose, and a minimal leakage of LDH activity into the extra-cellular medium. With both diets, colonocytes had a significantly higher capacity for glutamine and glucose utilisation (1–2 nmol/min, 10⁶ cells) than for butyrate or lactate (0.4–0.6 nmol/min, 10⁶ cells). Conversely, based on ¹⁴CO₂ production, the oxidative capacity was 2–3-fold higher for butyrate or lactate than for

glucose or glutamine. In all cases, glycolysis accounted for most of the glucose disappearance (60–75%), whereas oxidation accounted for 10–15% only. With both diets, butyrate (10 mM) was converted to ketone bodies (55%) and CO₂ (45%). Glutamine (5 mM) was converted to glutamate, ammonia, aspartate and alanine. Glutamine oxidation accounted for < 10% of the substrate disappearance. Both glycolysis and oxidation of glucose were significantly reduced in the presence of butyrate (10 mM), accounting for a 30% decrease in glucose utilisation. Butyrate (10 mM) did not affect glutamine metabolism. Glucose (5 mM) or glutamine (5 mM) had hardly any effect on butyrate metabolism.

With the high fibre diet, the capacity for glucose utilisation was significantly lower (0.8 vs 1.25 nmol/min, 10⁶ cells), due to a 30% decrease in glycolysis. The capacity for butyrate utilisation tended to be higher in colonocytes derived from pigs fed the high fibre diet (0.51 vs 0.37 nmol/min, 10⁶ cells).

In conclusion, a viable preparation of isolated colonocytes was obtained in the pig. Data suggest that butyrate is a major oxidative substrate in these cells, as previously found in rat and man (Roediger, 1980; Ardawi and Newsholme, 1985). Colonic cells from pigs adapted to a high fibre diet exhibited modified metabolic characteristics.

References

- Ardawi MS, Newsholme EA (1985) *Biochem J* 231, 713-719
- Roediger WEW (1980) *Gut* 21, 793-798