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Interactive effects of resistant starch with red and white meat diets on biomarkers of colorectal cancer

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Background – We have shown previously that high protein diets, including red meat, soy and casein, induce substantially greater colonic DNA damage in rats, than white meat and whey protein. This damage is opposed by resistant starch (RS). However, the reasons for differential effects of red and white meat on colorectal cancer (CRC) risk markers are unknown. Possible mechanisms include; 1) an increased production of free radicals in colonocytes and 2) an increase in serum insulin-like growth factor-I (IGF-I) concentration leading to greater cell proliferation and CRC risk.
Objective – To investigate the effect of dietary protein type and density on serum IGF-I, oxidised lipids and DNA damage in the colon mucosa and examine the protective role of dietary resistant starch.
Design – Rats were fed diets containing 15%, 25% or 35% cooked red meat or white meat, with or without RS as 20% high amylose maize starch (HAMS) for 4 weeks. Colonocyte DNA damage was assessed by the comet assay. Colonic epithelial malondialdehdye (MDA) was also measured as an indicator of oxidative damage. Hepatic portal and arterial serum was analysed for IGF-I.
Outcomes – Dietary red meat concentrations correlated positively with mucosal MDA ($r=0.46$, $P<0.05$) while feeding of HAMS maintained MDA concentrations at basal levels. There was a positive association between DNA double strand breaks and colonic mucosal MDA ($r=0.42$, $P < 0.01$). IGF-I concentration was positively associated with greater dietary protein density and was higher for white meat than red meat. Feeding of HAMS did not affect IGF-I concentration in the heaptic portal vein or aorta.
Conclusion – Genomic damage is a pre-requisite for oncogenesis and the data show that the association between red meat and CRC risk could be mediated through greater mucosal MDA which correlated with DNA strand breaks. These relationships were abolished by feeding RS. In contrast, plasma IGF-I was unrelated to DNA strand breaks suggesting that it is not involved in early stages of oncogenesis.

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Delivery of microencapsulated fish oil to the large bowel

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Background – Epidemiological and dietary intervention studies indicate the long chain (LC) n-3 polyunsaturated fatty acids (PUFA) from fish oil (FO) may reduce the incidence of inflammatory bowel disease and colorectal cancer. Further, *in vitro* studies have shown that eicosapentaenoic acid (EPA) or docosahexaenoic acid (DHA) and the short chain fatty acid (SCFA), butyrate, can cause apoptosis and cell death in human colon cancer cell lines.
Objective – The aim of the study was to design food grade matrices including resistant starch (RS) to deliver microencapsulated FO to the large bowel of the rat for potential therapeutic outcomes.
Design – The following dried emulsion formulations: 50% FO encapsulated in heated casein-glucose-dried glucose syrup (1:1:1) (Cas-Glu-DGS-50); 25% FO in casein-modified RS (Hylon VII) (1:1) (Cas-Hylon-25); or 25% FO in Cas-Glu-Hylon (1:1:1) (Cas-Glu-Hylon-25) were gavaged into rats for studies of (1) short-term (12 hours) or (2) long term (14 days) or (3) short term with [^{14}C]-trilinolenin as marker incorporated into the microcapsules to delivery FO to the large bowel. Preliminary digestion trials in simulated gastrointestinal fluids demonstrated that only 4-6% of oil was released from the emulsions.
Outcomes – A short-term study with FO and Cas-Glu-DGS-50 demonstrated the appearance of EPA and DHA into plasma indicating specific small intestinal absorption with little LC n-3 PUFA reaching the large bowel. A second long-term study with Cas-Glu-DGS-50 or Cas-Hylon-25 demonstrated that FO and Cas-Glu-DGS-50 LC n-3 PUFA were incorporated into tissue of the small intestine and colon, whereas Cas-Hylon-25 was resistant to degradation. A final short-term study using Cas-Glu-Hylon-25 with [^{14}C]-trilinolenin confirmed Hylon VII protected the microcapsules from breakdown with up to 60% of the labelled oil reaching the large bowel ($P<0.05$).
Conclusion – Depending on the microencapsulating matrix employed, fish oil can be delivered to the small bowel or by using RS, FO can be delivered to the large bowel with the added benefit of increased SCFA, and in particular butyrate, to the colon. These findings may have important health implications regarding diseases of the GI tract.