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## Intestinal absorption of glucose and insulin response in the pig: effect of supplementation with a low vs high viscosity seaweed fibre

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**Polar lipid composition and dietary sensibility for a marine mollusc.** P Soudant<sup>1</sup>, J Moal<sup>1</sup>, Y Marty<sup>2</sup>, JF Samain<sup>1</sup> (<sup>1</sup> Ifremer, BP 70, 29280 Plouzané; <sup>2</sup> URA CNRS 322, UBO, 29285 Brest, France).

The main phospholipid classes of the animal kingdom are found in *Pecten maximus* but are characterized by the presence of a particular glycolipid (GLY) especially rich in 22:6 (*n*-3) (80%) and of plasmalogens (PLSM) in substantial amounts (30%).

The separation and analysis of polar lipid fractions of the gonads were done following the method described earlier (*J Chromatogr B*, 1995, 673, 15–26) at different ages (0, 5 and 11 weeks). A preferential incorporation of 20 and 22 carbon PUFA was evidenced in polar lipid classes: 22:6 (*n*-3) in GLY and PLSM, 20:4 (*n*-9) in phosphatidylserine (PS).

The impact of dietary deficiency on the essential fatty acids 20:5 (*n*-3) and 22:6 (*n*-3) was studied on 3-year-old adults from the Bay of Brest by using three microalgal diets: *T-Isochrysis*, standard mixture and *C Calcitrans* with respectively 7.3%, 4.2%, 1.7% of 22:6 (*n*-3) and 0.5%, 16.2%, 23.8% of 20:5 (*n*-3). The eggs spawned by the scallop fed *T-Isochrysis* showed a better hatching rate and a lower atresia than those fed the other two diets (*Aquaculture*, 1996, 143, 361-378).

The dietary fatty acid composition clearly influenced the one of PC and PLSM, to a lesser extent the one of PS and PE, but the composition of PI and GLY did not vary. The 22:6 (*n*-3) level of PC and PLSM varied with the dietary amount of that fatty acid (24, 15.12 and 23, 17, 5% for PC and PLSM respectively). The involvement of PLSM and PC in the physico-chemical properties of the membrane and their associated cellular functions could explain the biological results. The high levels of 22:6 (*n*-3) in the PC and PLSM of the female gonads of broodstock fed *T-Isochrysis* could have

been responsible for the better gametogenesis and embryogenesis results.

**Intestinal absorption of glucose and insulin response in the pig: effect of supplementation with a low vs high viscosity seaweed fibre.** P Vaugelade, F Bernard, PH Duée, B Darcy-Vrillon (*UEPSD, Inra, 78352 Jouy-en-Josas, France*).

Soluble and viscous fibre added to a diet can slow down intestinal absorption of nutrients and modify insulin response. We tested the effects of two seaweed fibres: a low viscosity (xylans from *Palmaria palmata*, LVP), and a high viscosity product (alginate from *Laminaria digitata*, HVP).

Eight Large White pigs (59 kg) were implanted with permanent catheters in the portal vein and in the carotid artery, and with an ultrasonic portal blood flow probe. Eight to ten days after surgery, they received an alternate sequence of four test-meals (800 g or 400 g of a maize-starch + casein diet) supplemented with 5% fibre (40 g LVP vs 40 g purified cellulose -CEL-, 20 g HVP vs 20 g CEL). Blood glucose and insulin were monitored in the portal vein (PV), and in the carotid artery (CA), and the glucose absorbed quantified over 8 h after the meal.

The post-prandial rise in blood glucose and insulin did not differ between the LVP and CEL supplemented test-meals (peak level of blood glucose:  $7.3 \pm 0.4$  mM in PV, and  $5.2 \pm 0.3$  mM in CA; peak level of insulin:  $170 \pm 26$   $\mu$ U/mL in PV, and  $115 \pm 25$   $\mu$ U/mL in CA). Moreover, the amount of glucose absorbed over 8 h did not differ, accounting for  $67 \pm 5\%$  and  $60 \pm 7\%$  of starch ingested (360 g), with LVP and CEL respectively.

As compared to CEL addition, HVP modified blood glucose and insulin responses. Peak levels were reached later (60 vs 45 min), and were significantly lower:  $6.0 \pm 0.3$  vs  $7.6 \pm 0.5$  mM (PV) and

4.8 ± 0.3 vs 5.8 ± 0.4 mM (CA) for glucose; 62 ± 13 vs 159 ± 29 µU/mL (PV) and 35 ± 6 vs 120 ± 25 µU/mL (CA) for insulin. In addition, whatever the time after the meal, the amount of glucose absorbed was significantly lower for the HVP supplemented diet. Over 8 h, glucose absorption balance was significantly lower ( $P < 0.05$ ), accounting for 36 ± 4% (HVP) vs 71 ± 8% (CEL) of starch ingested (180 g). As demonstrated with other soluble viscous fibres (guar gum, pectins), this could be explained by a reduced gastric emptying of starch, or a modified glucose transport process in the small intestine.

Only the highly viscous fibre could modify the blood glucose and insulin response, and reduce glucose absorption balance across the intestine. We conclude that viscosity is a major factor controlling the effect of seaweed fibre added to a high carbohydrate diet.

**Effects of sulfated polysaccharides from green seaweeds (ulvans) on the survival, proliferation and differentiation of tumoral colonic epithelial cells (HT-29 and Caco-2).** C Bénard<sup>1</sup>, B Kaeffler<sup>1</sup>, M Lahaye<sup>1</sup>, HM Blottière<sup>1</sup>, JP Galmiche<sup>2</sup>, C Cherbut<sup>1</sup> (*Centre de recherche en nutrition humaine*, <sup>1</sup>Inra, BP 1627, 44316 Nantes; <sup>2</sup>Hôpital Laënnec, BP 1005, 44035 Nantes, France).

Sulfated polysaccharides from edible seaweeds may influence the intestinal mucosa through their polysaccharide backbone, their mineral contents or their sulfate residues. We have studied the biological activity of a sulfated or desulfated xyloglucuronorhamnan, extracted from *Ulva lactuca*, in human cell culture.

Ulvans were characterized by chemical analysis of their components. Biological activities were tested on HT-29 cell survival (neutral red) and proliferation (enumeration)

in a growth medium containing or not fetal calf serum, and on Caco-2 cell differentiation by measuring transepithelial resistance and intestinal enzymatic expression.

The desulfation did not modify the molar ratios of the others components. The survival of HT-29 with 0.5 and 2 g/L of native ulvans for 24 h in media with 0 or 10% of fetal calf serum was studied by a two-way variance analysis. This analysis revealed a positive effect of native ulvans on HT-29 cell survival ( $P < 0.0001$ ) and a negative interaction between ulvans and FCS concentrations ( $P = 0.018$ ). Native and desulfated ulvans at 0.5 g/L improved the HT-29 cells survival (in both medium). The HT-29 cell numbers with native ulvans for 6 days ( $7.18 \pm 0.49 \times 10^5$  cells/cm<sup>2</sup>) and desulfated ulvans ( $7.48 \pm 0.23 \times 10^5$ ) were superior ( $P < 0.05$  by Student's test) to the controls ( $5.39 \pm 0.44 \times 10^5$ ). The differentiation parameters were left unchanged.

In conclusion, ulvans could improve the HT-29 cell survival and stimulate the proliferation of these cells suggesting an effect of the polysaccharide backbone. Labelling of this polysaccharide backbone, for instance by biotinylation, will help to identify putative binding sites of ulvans onto HT-29 cell membranes.

**Involvement of β-elimination reactions in alginate fermentation by human intestinal bacteria.** C Michel, JL Barry, M Lahaye (*Inra, BP 1627, 44316 Nantes cedex 03, France*).

Fermentation of alginate, a common food additive, by human intestinal bacteria is typified by a latency phase and by a discrepancy in substrate disappearance and its metabolism into short chain fatty acids (SCFA). To investigate this behaviour, the role of β-elimination reactions, which are generally involved in alginate degradation by marine bacteria, was investigated.