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Cholecystokinin and Trypsin Responses of Larval Red Drum (*Sciaenops ocellatus*) in Response to Algae, Live Prey, and Inert Particles

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Abstract: In an attempt to better understand the problems in weaning larval fish to artificial diets, our lab has begun to investigate the role of the digestive hormone cholecystokinin (CCK). While there are a number of other labs also investigating CCK and other digestive hormones such as bombesin, PPY, and gastrin; research into the roles of these hormones in fish is still in its infancy. Previous research with red drum larvae suggests that some component of rotifers and algae enable red drum larvae to more efficiently utilize microparticulate diets than when these are not included in the culture system. The current work investigated the impact of soluble components of rotifers and algae on the CCK and trypsin responses of larval red drum at 6 and 10 days post hatch (DPH) as well as the response of red drum larvae to ingestion of inert polystyrene particles at 10 DPH. Introduction of homogenized rotifers was shown to significantly increase whole body CCK levels, CCK mRNA, and trypsin activity in 6 DPH red drum larvae, but not in 10 DPH larvae. Homogenates of *Isochrysis galbana* did not significantly affect CCK or trypsin at either age. Ingestion of the polystyrene particles was increased in response to the presence of rotifer homogenate and both CCK mRNA and trypsin activity was increased as well. This research suggests that there is a soluble component of rotifers that can upregulate digestive function in larval red drum, at least in 6 DPH larvae, as well as influence consumption.

Annotated Bibliography

Dockray G. J., 2012: Cholecystokinin. Current Opinion in Endocrinology, Diabetes & Obesity, **19(1)**, pp 8–12.

The author provides an excellent review of the current understanding of the role of Cholecystokinin (CCK) in satiety and to a lesser extent, digestion. The author focuses on the role of CCK in the cephalic phase and reviews current knowledge of both CCK activators and targets. The author also discussed the role of Leptin in potentiating the effect on CCK on vagal afferent neurons. Of particular note in this manuscript, the author mentions the role of GPR40 and long-chain fatty acids in the secretion of fatty acids while much of the other literature focuses on protein hydrolysate / amino acid roles in promoting CCK secretion.

Liou A. P., Chavez D. I., Espero E., Hao S., Wank S. A., and Raybould H. E., 2010: Protein hydrolysate-induced cholecystokinin secretion from enteroendocrine cells is indirectly mediated by the intestinal oligopeptide transporter $PepT_1$. *Am. J. Physiol. Gastrointest. Liver Phsyiol.*, **300: G**, G895-G902.

The authors investigate the role of the $PepT_1$ transporter as the direct mediator of Cholecystokinin (CCK) secretion in response to protein hydrolysate. Before this work, $PepT_1$ was considered a likely mediator of direct mediation of CCK secretion due to previous work that showed a synthetic dipeptide, Gly-Sar, used in $PepT_1$ kinetic studies caused a dose-dependent inhibition of gastric motility consonant with CCK secretion. The work demonstrated that while Gly-Sar did inhibit gastric motility it had no effect on eliciting CCK secretion from CCK-eGFP

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cells. Based on this work, the authors concluded that protein detection by intestinal I cells likely includes both direct and indirect detection but that $PepT_1$ does not have a direct role in CCK secretion. The authors do however suggest that $PepT_1$ may function indirectly by stimulating a diazepam-binding inhibitor.

Cudenneca B., Fouchereau-Peron M., Ferry F., Duclos E., and Ravallec R., 2012: *In vitro* and *in vivo* evidence for a satiating effect of fish protein hydrolysate obtained from blue whiting (*Micromesistius poutassou*) muscle. *J. Func. Foods.*, **4**, 271–277.

The authors in this work examine the role of protein hydrolysate from blue whiting on CCK secretion in STC-1 cells as well as on long and short-term food intake of rats fed blue whiting muscle hydrolysate (BWMH). The authors found that in the *in vitro* studies on STC-1 cells, peptides from the BWMH stimulated CCK secretion in a dose-dependent response similar to that seen from other types of protein hydrolysate. In the *in vivo* study, the authors found that BWMH produced short-term reductions in food intake but that this reduction was not reflected in the long term. The *in vivo* study did show that blood CCK and GLP-1 levels were more than doubled in rats fed 100 and 250mg of BWMH following a 24h fast lending credence that these may be involved in the short-term decrease in consumption.