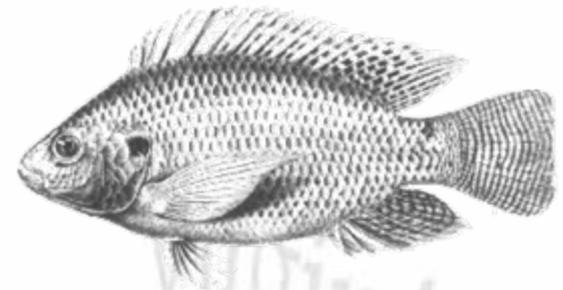
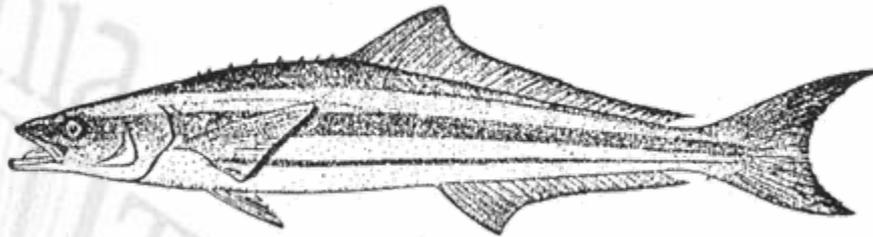


# Total Replacement of Fish Meal and Fish Oil in Diets for Nile Tilapia and the Marine Obligate Carnivore, Cobia



Steven R. Craig and Ewen McLean

Va/Md Regional College of Veterinary Medicine

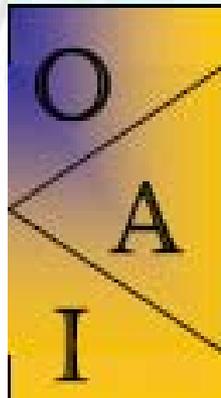
College of Natural Resources

Virginia Polytechnic Institute and State University



# Organic Research @ the Virginia Tech Aquaculture Center (VTAC)

- ❖ Investigations into certifiable organic alternate protein sources since 2003—laboratory scale, tilapia and cobia
- ❖ Commercial scale field trials with marine shrimp since 2004 in conjunction with the Organic Aquaculture Institute (Imperial, Texas)
- ❖ Alternate lipid work underway with cobia



# Alternate Protein Investigations

@ the VTAC



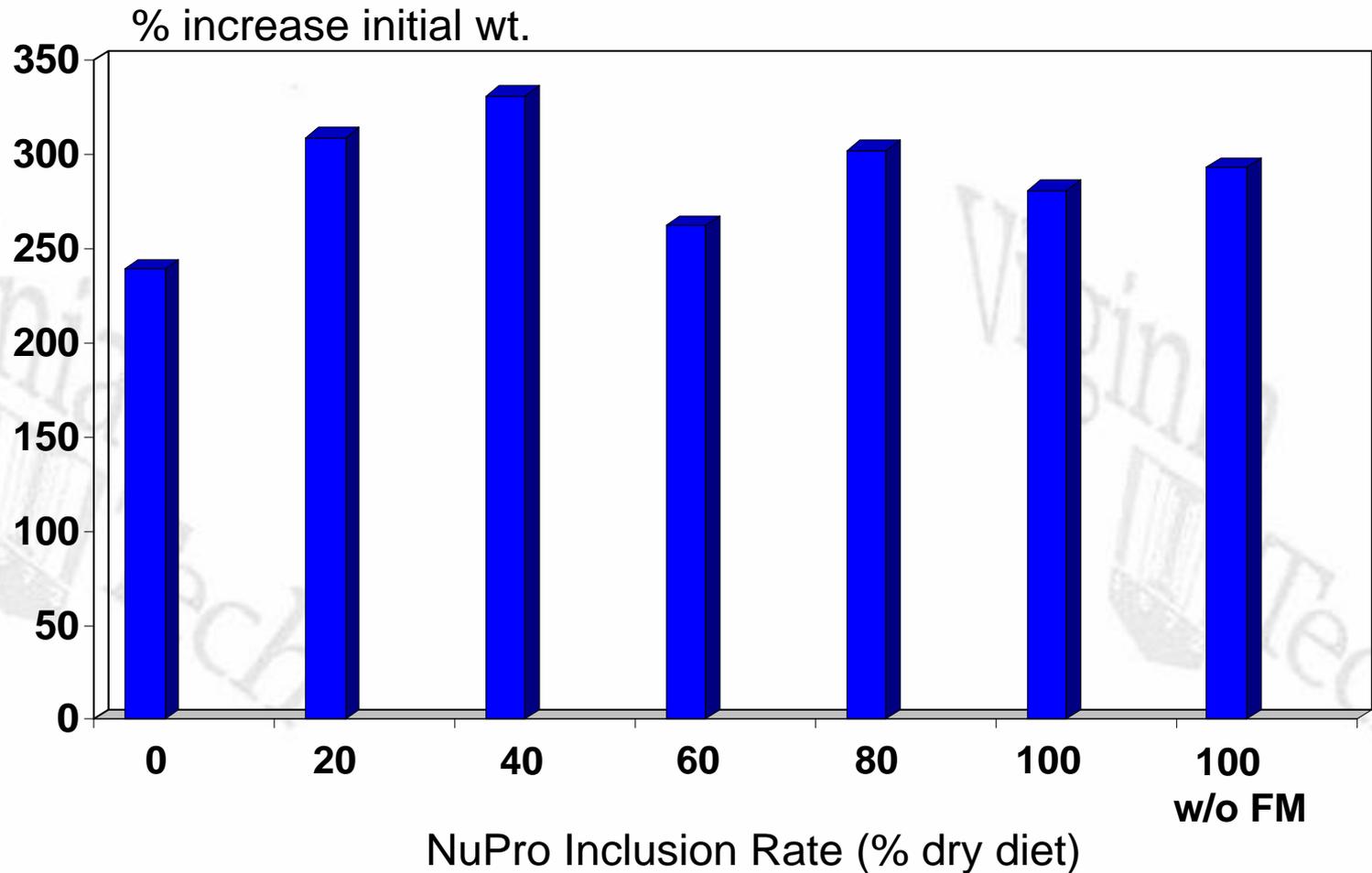
- ❖ Organic protein sources few and far between—especially for aquafeeds
- ❖ Expensive!!
- ❖ Certified protein sources utilized—soybean meal, soy concentrate, soy isolate, hemp meal
- ❖ Certifiable alternate protein source--NuPro® (Alltech Inc., Nicholasville, KY)—single cell protein source (yeast)
- ❖ 10 feeding trials completed to date, tilapia and cobia—40-100% fish meal replacement

# Fish Meal Replacement with Tilapia

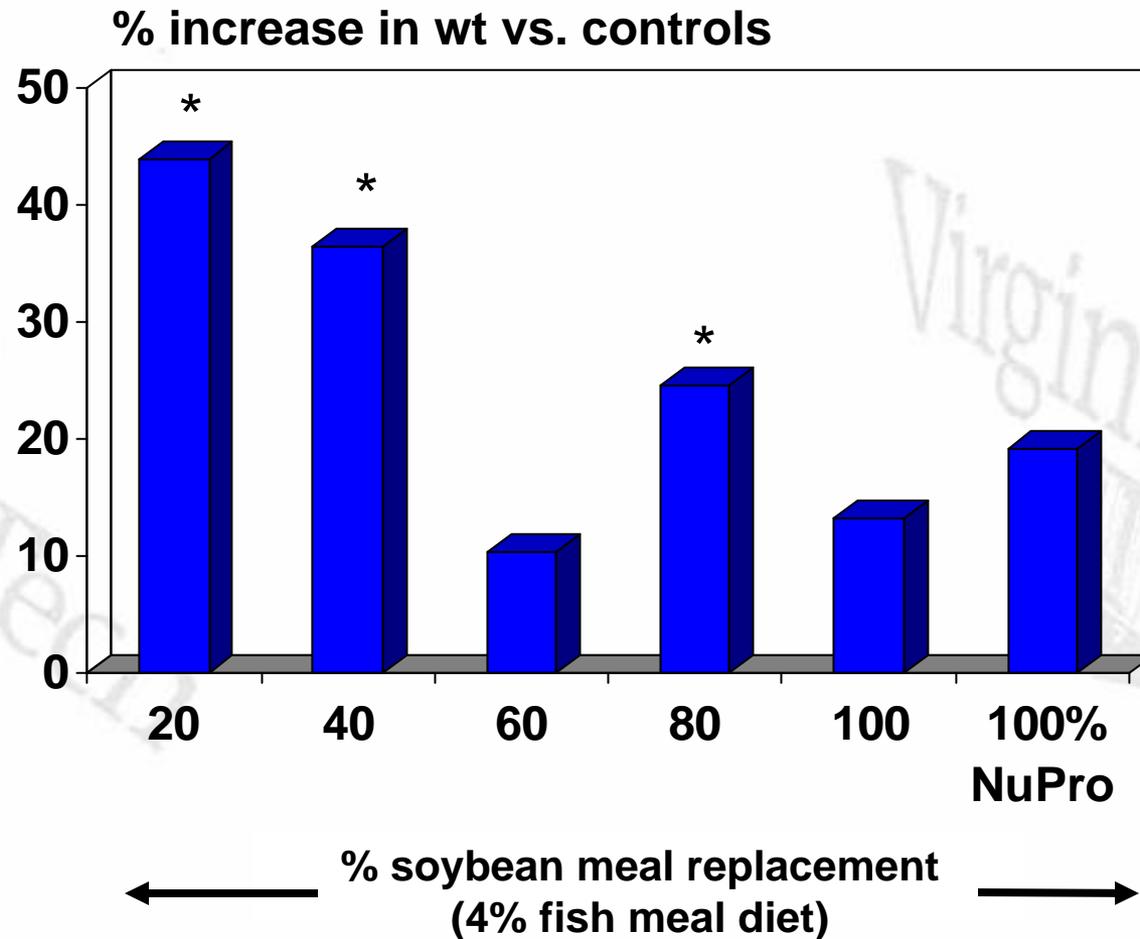
- ❖ Tilapia easier fish to replace fish meal
- ❖ 10 week feeding trial
- ❖ 0-100% replacement of conventional soybean meal with NuPro® (4% fish meal in all diets)
- ❖ 100% replacement of all protein sources with NuPro®
- ❖ Weight gain, feed efficiency, biological indices monitored



# Organic Proteins in Tilapia Feeds



# NuPro® Tilapia Study



# Alternate Protein Investigations with Cobia @ the VTAC

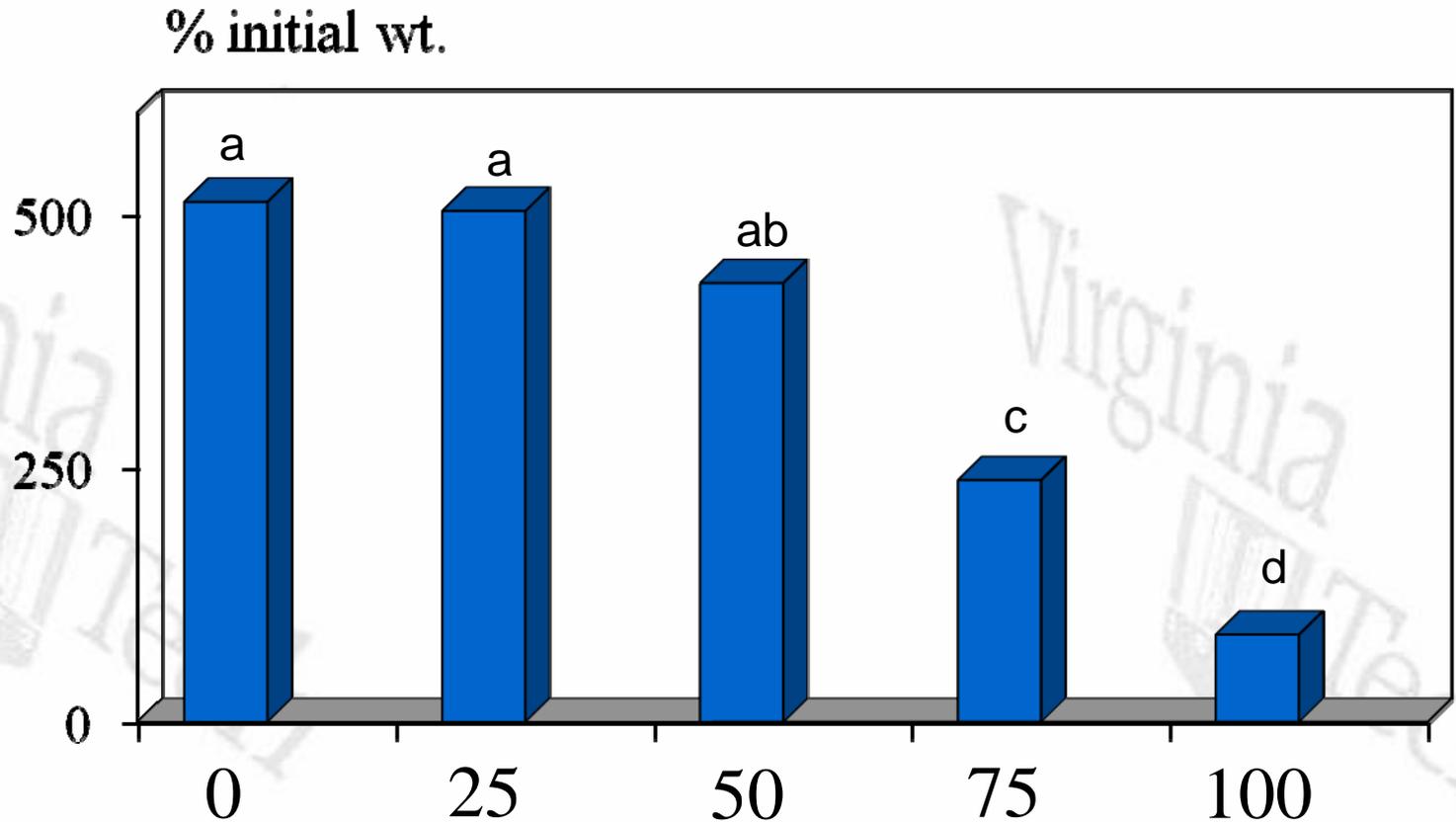


- ❖ Cobia one of most exciting fish for aquaculture
- ❖ 20+ trials on juvenile nutrition at the VTAC
- ❖ Nutritional requirements to fish meal and fish oil replacement
- ❖ ALL alternate protein work with organically certified/able sources—some novel
- ❖ Success with total replacement (with caveats)

# Fish Meal Replacement with Cobia

- ❖ Incremental replacement levels—0-100%
- ❖ With and without amino acid supplementation—blended sources?
- ❖ Utilized menhaden fish oil for n-3 HUFA requirements
- ❖ 6-8 week studies
- ❖ Weight gain, feed efficiency and biological indices

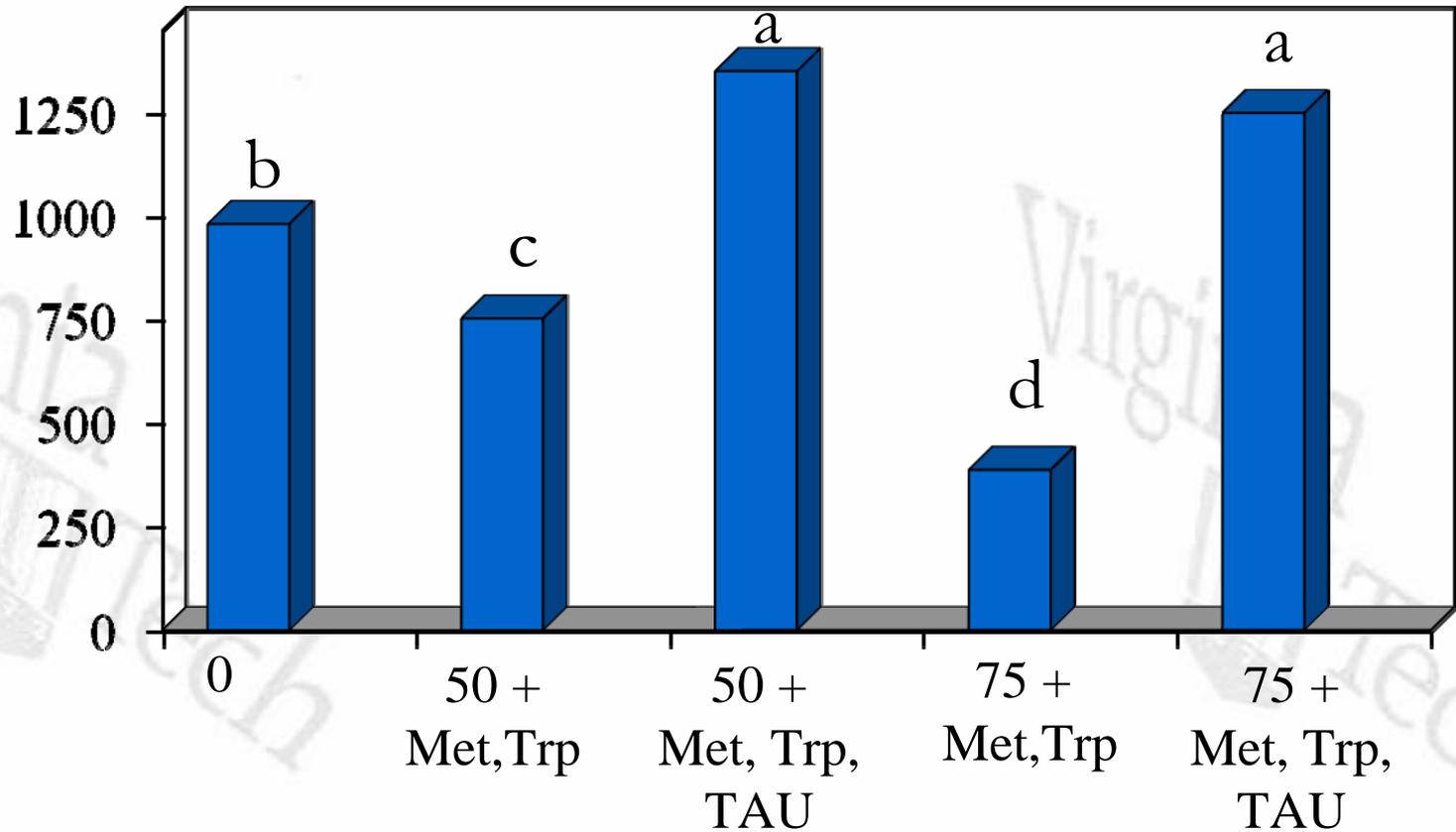
# Weight Gain Lunger et al. (2006)



NuPro inclusion rate (% dietary protein)

# Weight Gain--NuPro + AA's

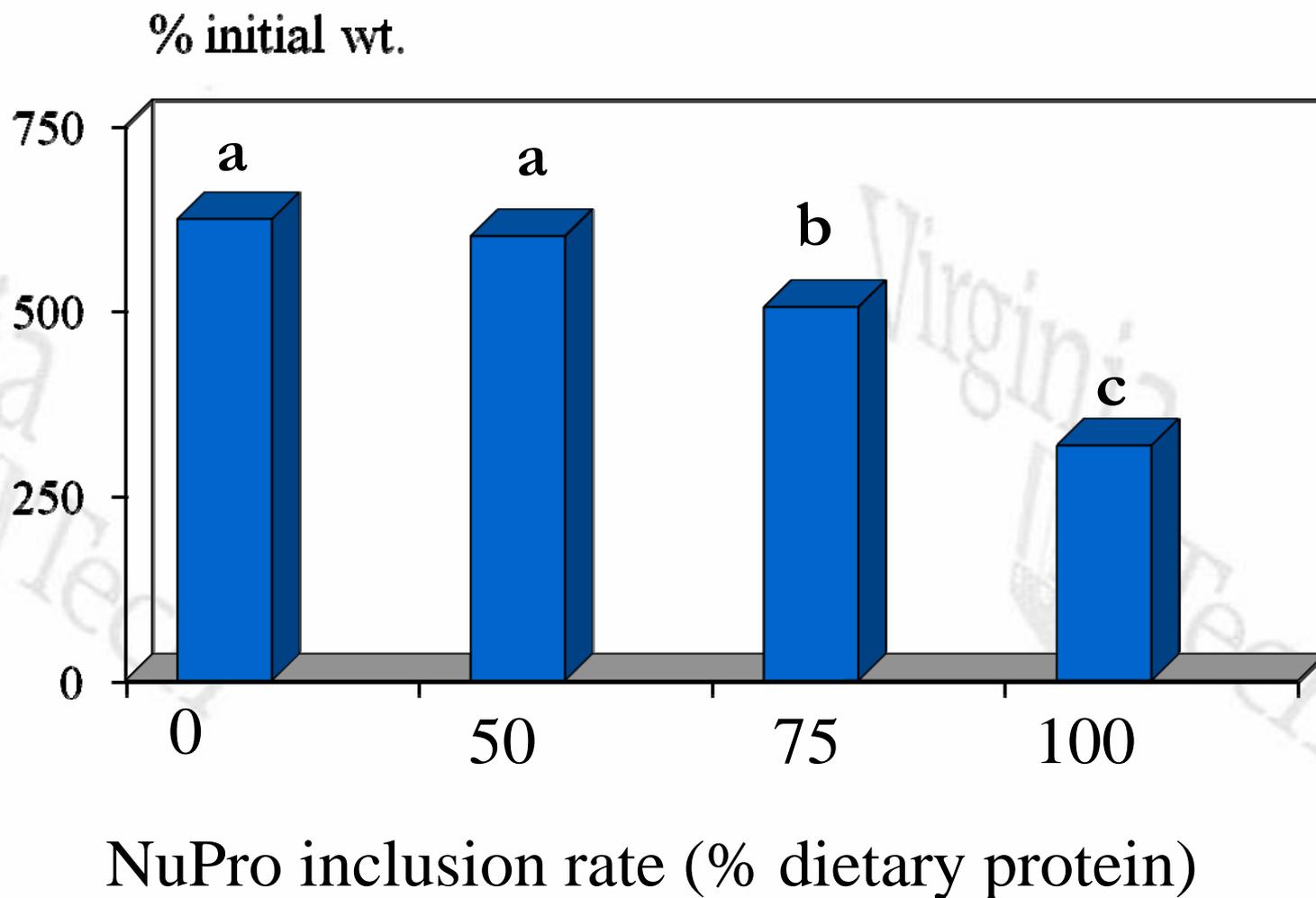
% initial wt.



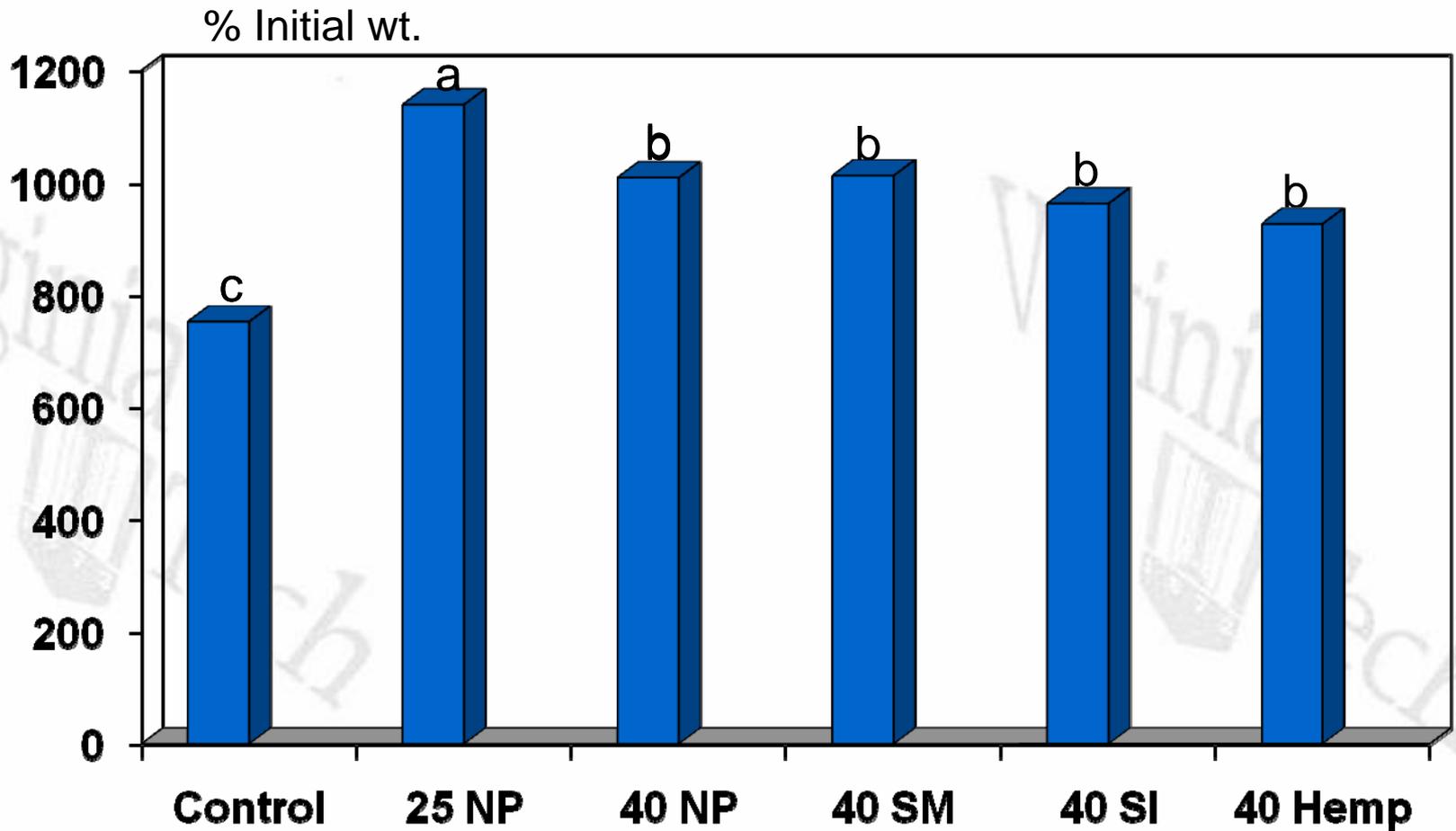
NuPro inclusion rate (% dietary protein)



# Weight Gain—NuPro + Taurine



# Weight Gain (Lunger et al. 2007)



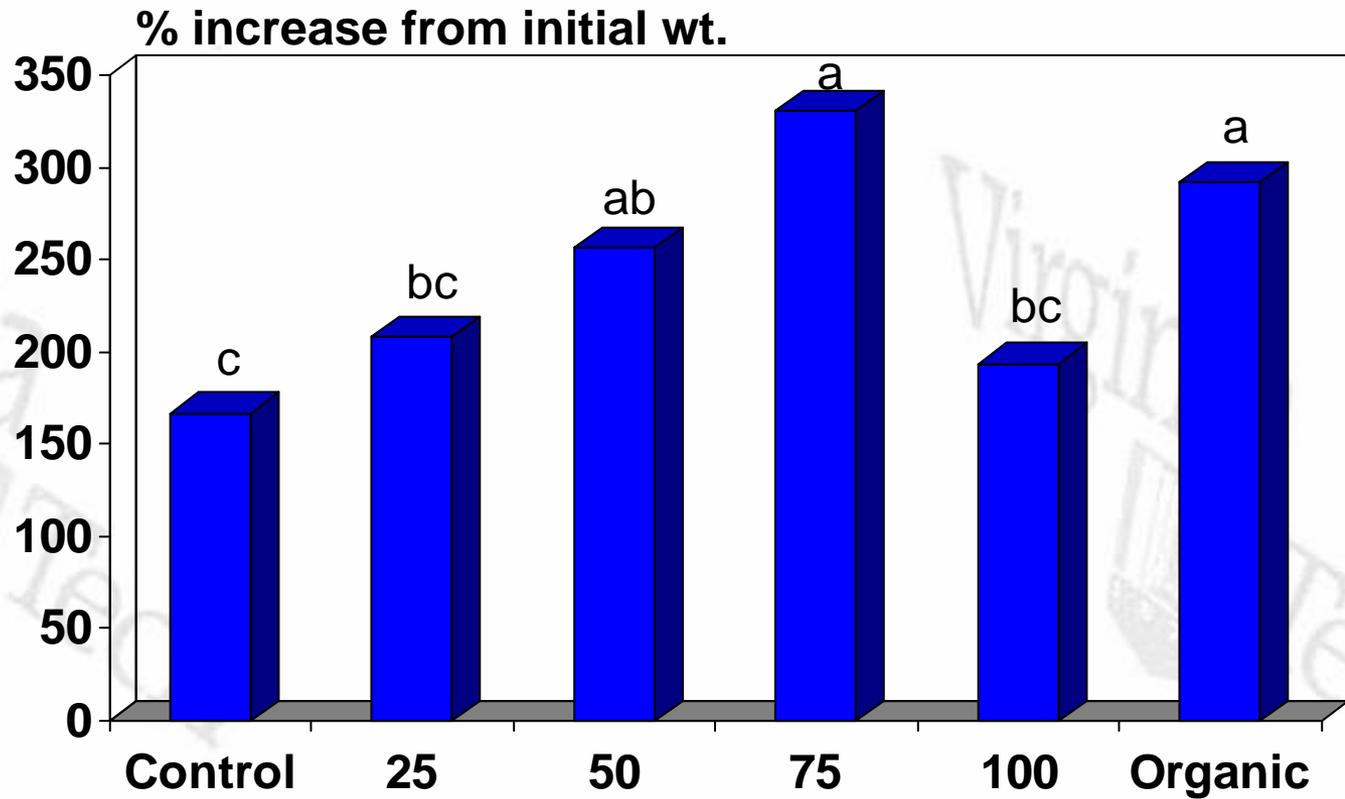
# Novel alternate protein sources:

## *Neried* worms

- ❖ Marine worms—rag worms, fish bait
- ❖ Relatively high protein content—50-55%
- ❖ Endogenous lipids—n-3 HUFA—no need for fish oil
- ❖ 2 separate trials, 0-100% replacement of fish meal in cobia diets

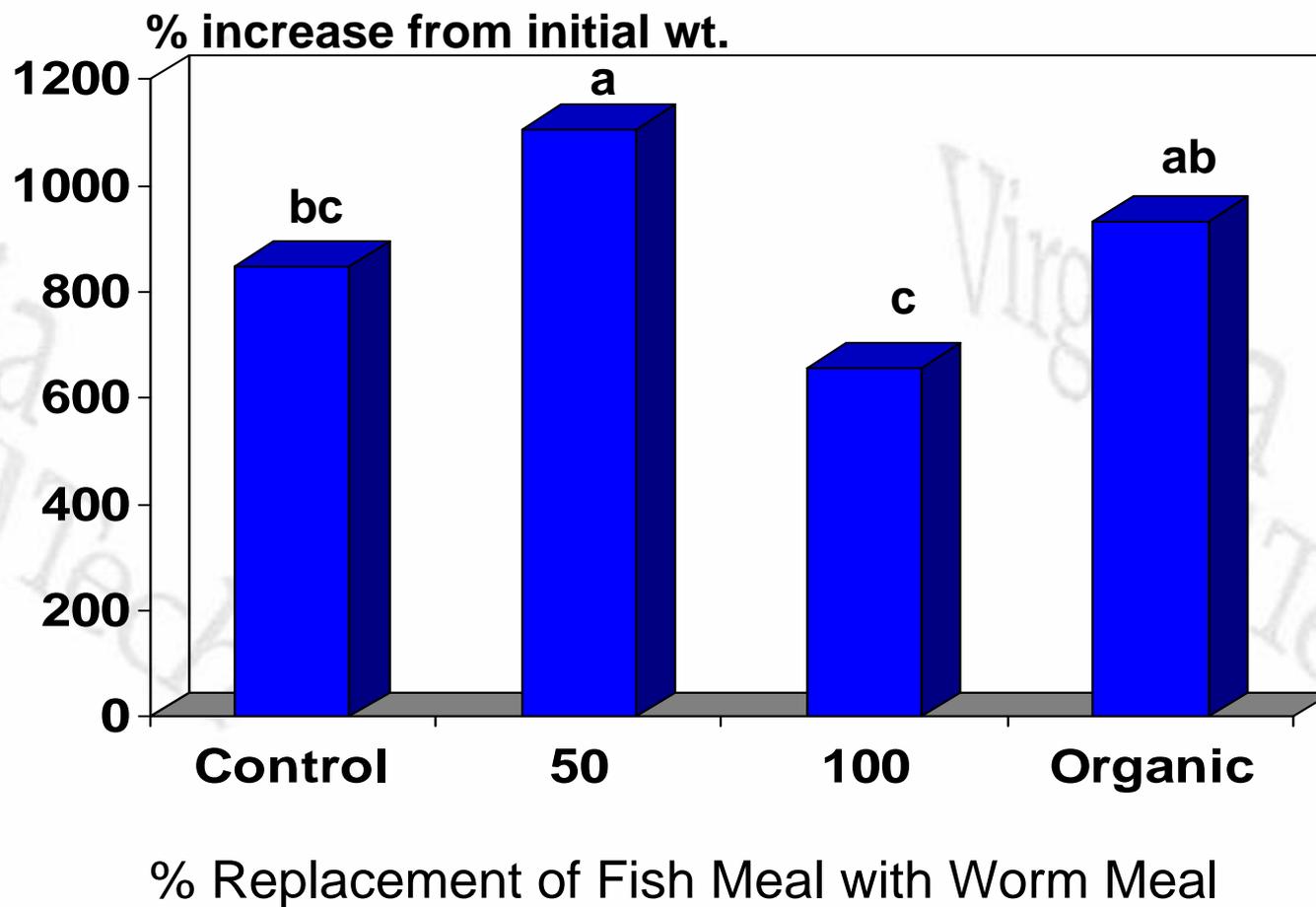
# Cobia Worm Trial 1:

35 g initial weight



% Replacement of Fish Meal with Worm Meal

# Cobia Worm Trial 2: 13 g initial weight



# Summary and Conclusions

- ❖ Tilapia, marine shrimp and cobia can all be cultured on aquafeeds that contain NO fish meal or fish oil!
- ❖ Supplemental AA's may be necessary (met, tau), BUT, maybe not (blended organic protein sources)
- ❖ Some animals are easier than others to culture organically
- ❖ Others just cannot be produced under organic guidelines—IT SHOULD BE DIFFICULT!!
- ❖ **Protect the Organic Label at All Costs**