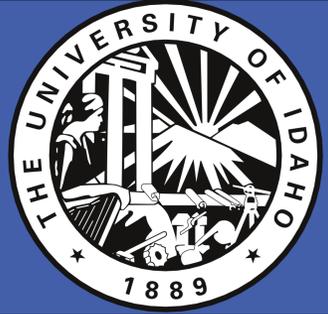


# DIETARY EVALUATION OF EnzoMeal™ (PROCESSED SOYBEAN MEAL) vs COMMERCIAL SOYBEAN MEAL FOR RAINBOW TROUT FEED

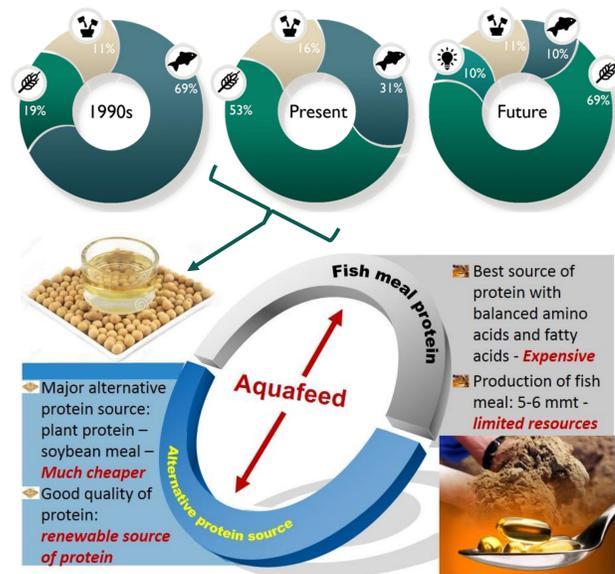


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## INTRODUCTION

There is an increasing strain on fishmeal (FM) usage in aquafeeds due to the rapid growth of aquaculture and its demand for essential amino acids and fatty acids (Naylor *et al.*, 2009). Currently, aquaculture alone uses 76% of the world's fishmeal and in addition, aquaculture is in urgent need of alternative protein sources.



Soybean meal (SBM) is one of the most promising alternatives because of its availability, reasonable price and high digestibility (Kumar *et al.*, 2011). Nevertheless, when compared to FM, SBM has lower essential amino acids (NRC, 2011) with anti-nutritional factors (ANFs) that may reduce the nutritive value in aqua feeds (Francis *et al.*, 2001). **To improve the nutrient quality, we have developed a new technology to reduce the anti-nutritional factors and enhance the protein content from SBM without compromising the nutritional value.** This product is called EnzoMeal™ (EM).

Table 1: Comparative nutritional value (%) of SBM vs. EM

	SBM	EM	EM benefits over SBM
Protein	45.9	56	22% increased
Carbohydrate	39.85	27.5	45% decreased
Oligosaccharide	15	<0.05	~100% removal
Phytic acid	1.85	0.88	55% decreased
Protein digestibility	71	79	11% increased

## GOAL & OBJECTIVES

The overall goal of our project is to **increase the usage of EnzoMeal in rainbow trout (*Oncorhynchus mykiss*).**

**Objectives:** To determine how replacement of dietary FM with EM and SBM feedstuffs effects on:

- growth performance and feed efficiency
- gut histology of rainbow trout

## MATERIALS & METHODS

### Experimental setup:

- ✓ Rainbow trout (n=720, av wt: 5 g): eighteen 145-L tanks (40 fish per tank)
- ✓ Flow-through system, 14°C spring water
- ✓ Apparent satiation (3 times/day) for 12 weeks
- ✓ Fish were batch-weighted every 3 weeks

**Experimental diets:** Six isonitrogenous (45% protein) and isolipidic (21% lipid)

	Control	Low		High		Mix
Ingredients	FM	SBM	Enzo	SBM	Enzo	SBM+Enzo
Fishmeal	25	17	17	9	9	9
Soybean	0	10.5	0	21.0	0	9.61
EnzoMeal	0	0	9.0	0	18.0	9.61



Figure 1: Soybean meal (A), EnzoMeal (B) and experimental setup (C)

**Statistical analyses:** All data were subjected to a one-way analysis of variance (ANOVA) followed by Duncan's multiple range test if p<0.05. All statistical analyses were performed using the SAS software.

## RESULTS

### Growth performance and feed efficiency:

- ✓ Fish fed Enzo showed higher growth performance and protein retention than fish fed SBM at each level.
- ✓ Compared with the low SBM treatment group, there was a 51% growth increase in the low Enzo treatment group without any significant effects on FCR or feed intake.
- ✓ A larger growth increase of 166% was observed at high Enzo treatment compared to the high SBM treatment, along with significantly improved FCR and feed intake.
- ✓ A similar pattern was also found with protein retention

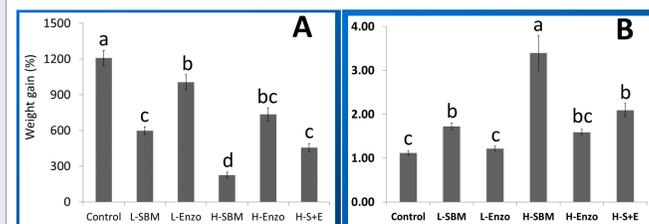


Figure 2: Growth performance (weight gain %) (A) and feed conversion ratio (B) in rainbow trout fed with experimental diets

- ✓ Whole-body content of some essential amino acids (e.g. isoleucine, leucine and valine) showed a significant corresponding decrease with high dietary SBM inclusions.
- ✓ Trypsin activity in the proximal intestine decreased significantly with increasing dietary SBM and Enzo levels.

## RESULTS

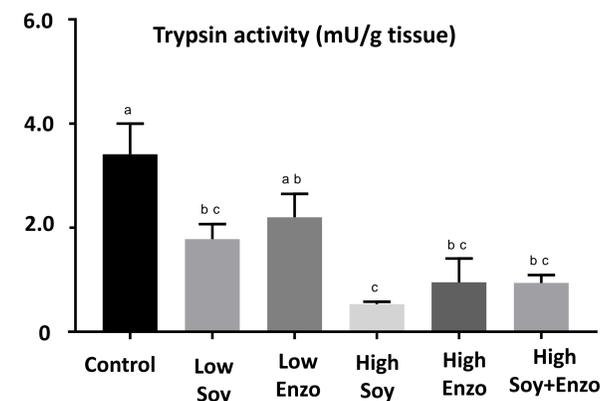


Figure 3: Levels of trypsin activity of proximal intestine

### Intestinal histology:

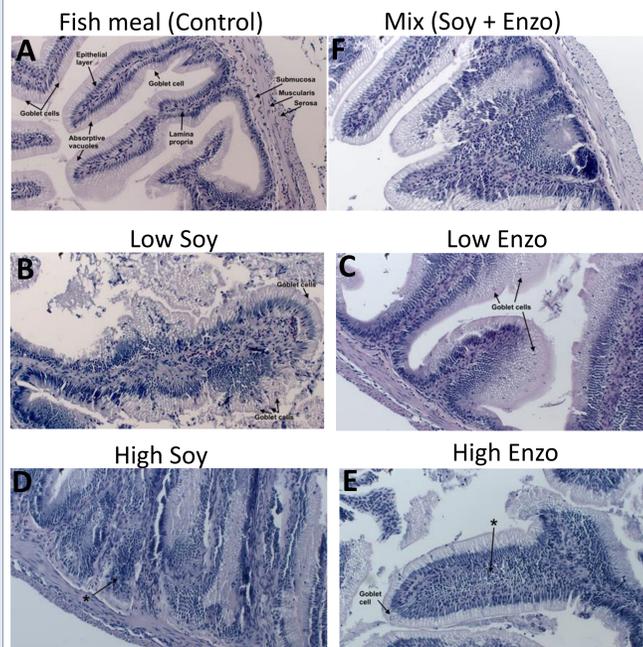


Figure 4: Overview of histological sections of the distal intestines of rainbow trout (Hematoxylin and eosin staining with magnification = 40X)

- Control group did not exhibit any sign of changes
- Low soy fed group exhibited inflamed muscularis, leukocyte infiltration of the lamina propria leading to swelling and mucosal fold fusion (bridging). Increased prevalence of goblet cells, possibly to secrete more mucous to protect the epithelium whereas Enzo fed group showed less inflammation.
- High inclusion of soy and Enzo showed villi and lamina propria highly inflamed (leading to much wider mucosal folds), however no change to mucous cell prevalence or inflammation to muscularis was found in Enzo group
- Mix group also showed shortened villi, inflamed muscularis, disorganization of villi.

## DISCUSSION & CONCLUSION

- ✓ EnzoMeal has 22% higher protein than conventional soybean meal by maintaining the amino acid composition.
- ✓ It is a low-cost technology to remove the ANFs for sustainable aquaculture.
- ✓ The results of this study demonstrate that EnzoMeal significantly improved the growth and feeding efficiency of rainbow trout.
- ✓ **51% and 166% higher growth was observed in EM fed groups** at low and high inclusion level respectively than SBM fed groups.
- ✓ For future research, a long-term feeding trial of EnzoMeal should be done to evaluate fish filet quality.
- ✓ Overall, EnzoMeal is a potential alternative ingredient for aquafeed industry.

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