

COMPARATIVE NUTRITIONAL EVALUATION OF PROCESSED SOYBEAN MEAL (EnzoMeal™) vs COMMERCIAL SOYBEAN MEAL IN NILE TILAPIA

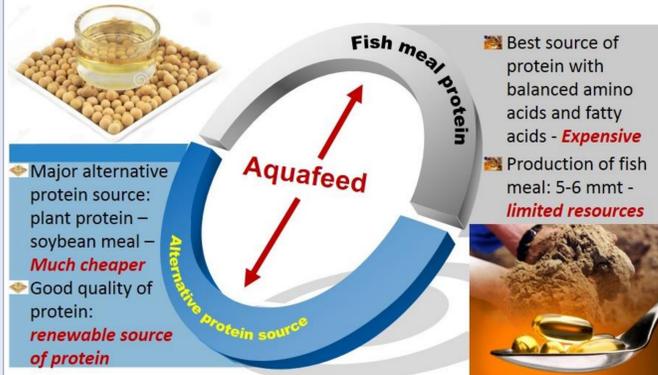


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INTRODUCTION

Aquaculture farms currently supply their fish nutritional requirements through commercial diets that contain marine fish meal (FM), which has favorable nutrient profile. However, there is an increasing strain on fish meal 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.



Over the past few decades, a wide variety of plant ingredients have been evaluated as potential alternative protein sources. Compared to other plant sources, conventional soybean meal (SBM) is one of the most promising alternatives because of its availability, reasonable price, high digestibility (Kumar et al., 2011). Nevertheless, when compared to FM, SBM has lower essential amino acid concentrations and deficiencies in methionine, lysine, and threonine (NRC, 2011). It has anti-nutritional factors (ANFs) that may reduce the nutritive value of aqua feeds (Francis et al., 2001). Hence, there is a need to improve the nutrients profile of SBM. **Recently, 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 nutritive 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	1.52	0.88	42% decreased

GOAL & OBJECTIVES

The overall aim of our project is to *increase the usage of EM in Nile tilapia.*

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

- growth performance and feed efficiency
- gut histology of Nile tilapia

MATERIALS & METHODS

Digestibility study: Reference diet contain 12% fish meal (38% crude protein and 9% lipid). Both experimental diets (reference and test) fed in replicate to two tanks (500 l) of fish. Fecal matter was collected by hand net.

Calculations of apparent digestibility coefficients of test ingredient: Apparent digestibility coefficients (ADC) of EM and SBM calculated for dry matter, protein, amino acids, lipid using the formula described by Bureau et al. (2002).

Experimental diet for growth study: Three isonitrogenous (38% crude protein) diets were formulated: **Diet 1: Control:** 20% FM; **Soy:** 50% FM replaced by SBM and **Enzo:** 50% FM replaced by EnzoMeal.



Experimental setup:

- Feeding trial: re-circulating aquaculture system
- Three tanks were randomly assigned per diet.
- 15 fish (av. wt.: 9.0 g) per tank in 9 tanks (25 l)
- Feeding trial: 9 weeks
- Feeding rate: three times/ day at satiation level
- Water quality: Temp. 26 °C and pH: 7.0

Sampling: Distal intestine samples from each treatment were taken to assay the activities of digestive enzyme, and gut histology. Six fish from each aquarium sampled for whole-body proximate composition and amino acids analyses. Gut histologic examinations were conducted according to our lab protocol.

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

Apparent digestibility coefficient of EnzoMeal for dry matter, protein and essential amino acids were higher than SBM. Results from this study reveals that EnzoMeal based fed group exhibited higher ($P<0.05$) growth than FM (control) and SBM fed groups (Figure 1).

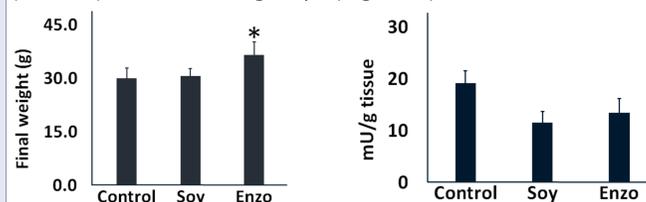


Figure 1: Final weight (g) of fish (A) trypsin activity (B) in proximal intestine of Nile tilapia. Values are mean (n = 3) ± standard deviation. Mean values with different asterisk differ significantly (P<0.05).

RESULTS

Dietary treatment did not affect the feed intake among the groups. Feed conversion ratio (feed fed/body mass gain) and trypsin activity in proximal intestine of fish were not significantly different among the groups (Figure 1).

Proximate composition of whole body:

- Moisture and protein content was higher in control than soy and Enzo fed groups.
- Highest lipid content was observed in Enzo which was similar to soy group and lowest value for control.

Amino acids composition of whole body:

- Most of the essential amino acids were not significantly different among the groups except lysine and cysteine.
- Lysine deposition was higher in Enzo fed group than control.
- Cysteine content was lower in Enzo fed group than control.

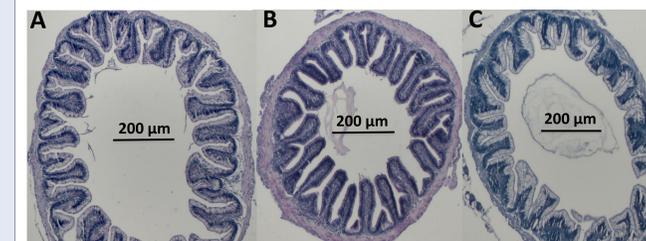


Figure 3: Overview of histological sections of the distal intestines of Nile tilapia representing the controls (A), soy (B) and EnzoMeal (C) fed groups. Magnification = 20 X; Hematoxylin and eosin staining.

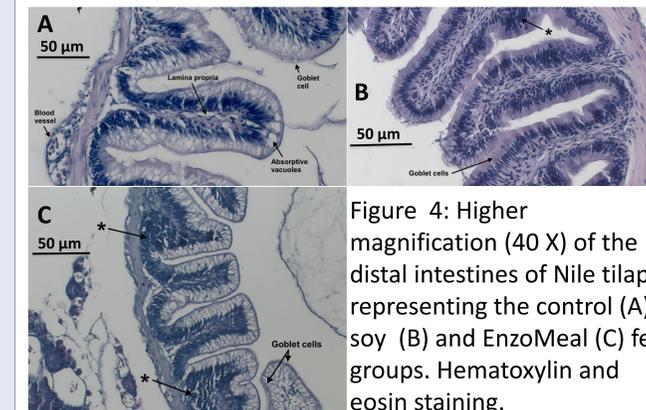


Figure 4: Higher magnification (40 X) of the distal intestines of Nile tilapia representing the control (A), soy (B) and EnzoMeal (C) fed groups. Hematoxylin and eosin staining.

Distal intestine of control group did not exhibit any sign of villi inflammation and mucosal changes. Soybean meal fed group (Fig 3B) exhibited mucosal folds a bit shorter, some inflammation of lamina propria, reduction in supranuclear absorptive vacuoles whereas EnzoMeal group (3C) showered mucosal folds shorter, some villi inflammation.

DISCUSSION & CONCLUSION

- Based on the current study it looks like that EnzoMeal is highly digestible therefore growth performance of EnzoMeal fed group were higher than soy and control groups. Further study is warranted to optimize the inclusion level of EnzoMeal in tilapia feed.
- In this study, moisture content of whole body of fish exhibited an inverse relationship with lipid content.
- EnzoMeal fed groups showed higher growth rate than SBM fed group whereas FCR (numerically) exhibited opposite trend. Trypsin enzyme activity in intestine was significantly similar among the groups. Villi of soy and EM fed groups showed villi inflammation.
- Overall, this study suggests that there is potential for more than 50% replacement of fishmeal with an alternative, sustainable, plant protein such as processed soybean meal (EnzoMeal™) for Nile tilapia feed.

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