Nutritive adaptation in Nile tilapia (*Oreochromis niloticus*) to *Tenebrio mollitor* meal as protein source diet: effect in fish growth and performance

C. de Haro*, F.G. Barroso, L Hidalgo, F. Uclés, M.J. Sánchez-Muros.
Department of Applied Biology. University of Almería. Spain.
E-mail: cdd822@ual.es

ABSTRACT

This experiment is an initial study on the inclusion and adaptation to insect meal in the diet of fish farm, as alternative protein of fish meal. The results show that Nile tilapia has a good acceptance to the flour of insects, which is more economical and viable to produce. Nile tilapia previously fed with tenebrio meal, and after with fish meal, show a compensatory growth even better than fish fed with control food throughout the experiment. The results open a new window in aquaculture feeding alternatives to fish meal.

INTRODUCTION

To the date fishmeal is the main source of protein for our aquaculture feed but their use is unsustainable.Globally there are very few studies that have focused on getting protein from insect meal. Two advantages that initially seem to be promising are: (1) they suppose no competition with food sources for humans in our context, (2) being of animal origin, it can adapt to the digestive physiology of fish easily, overcoming the limitations in this respect with.

MATERIAL AND METHODS

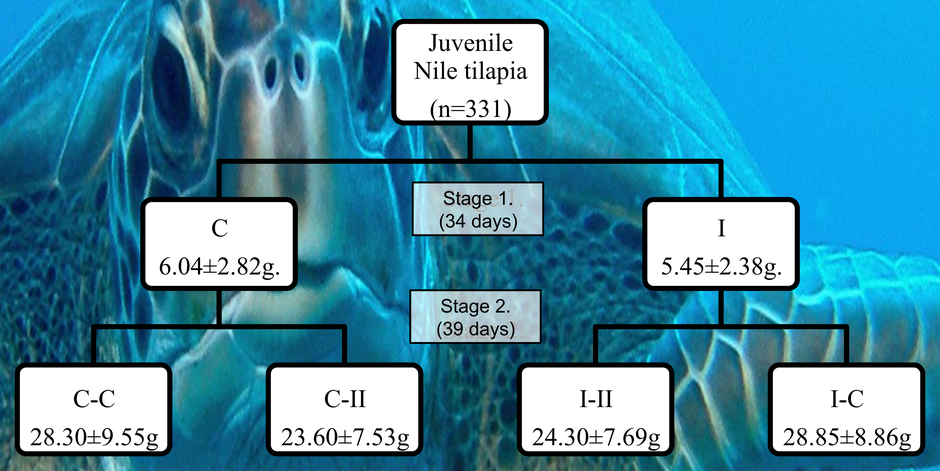
Three experimental diets were prepared using different percentages of fish meal (FM) and *Tenebrio mollitor* larvae insect (TM), as the protein source alternative, together with the rest of the diet ingredients (cereal, fish oil, premix, and celulose). The analysis of the macronutrients diet composition (AOAC 2000) are shown in the follow table expressed in % of dry matter (different letters denote statistical significant difference between average, P<0.05).

DIET	CONTROL (C)	INSECT 1. (I)	INSECT 2. (II)
Composition	100% FM	25%TM-75%FM	50%TM-50%FM
Dry matter	91.36 a	89.87 b	90.63 ab
Ash	19.59 a	13.51 b	10.52 c
Ether extract	10.08 b	10.37 b	12.09 a
Crude Portein	44.12	44.73	45.10

Nile tilapia (*Oreochromis nioticus*) with one week old.

Tenebrio mollitor larvae as alternative protein source.

The experiment was conducted in two stages of adaptation (*graphic 1.*) with juvenile Nile tilapia (*Oreochromis niloticus*) with one week old, in 60l tanks (stage 1) and 300l tanks (stage 2).



Graphic 1. Stages of adaptation to tenebrio meal. n is the number of initial fish, that were evenly distributed to each tratment. The diet maintained it's indicated with th mean of final fish weights of each treatment with his std Dev.

To evaluate the growth, nutritive and morphometric indixes related with the feed production were determined. At the end of the stage 2., 15 fish per diet were measured, weighed, and dissected. The results are show as the Mean±StdDev. Different letters indicate significant differences.

CALCULATIONS

Body components: % of muscle, liver, carcass, intestines, stomach, spleen, head, gonads and perivisceral fat.

Condition factor = $\frac{100 \bullet BodyWeight}{TotalLength^3}$

IBW: Initial body weight (g).
FBW: Final body weight (g).
IBL: Initial body lenght (cm).
FBL: Final body lenght (cm).

SGR = Specific growth rate = $\frac{\ln W_f - \ln W_i}{t} \bullet 100$

Where W_f and W_i represented the final and inicial weights respectively, and t is the duration in days of the experiment.

DIF = Daily intake by fish.

FI = Feed intake = $\frac{FeedDailyIntake}{AverageBodyWeight} \bullet 100$

FE = Feed efficiency = $\frac{WetWeightGain}{DryFeedIntake}$

PER = Protein efficiency ratio = $\frac{WetWeightGain}{CrudeProteinIntake}$

RESULTS

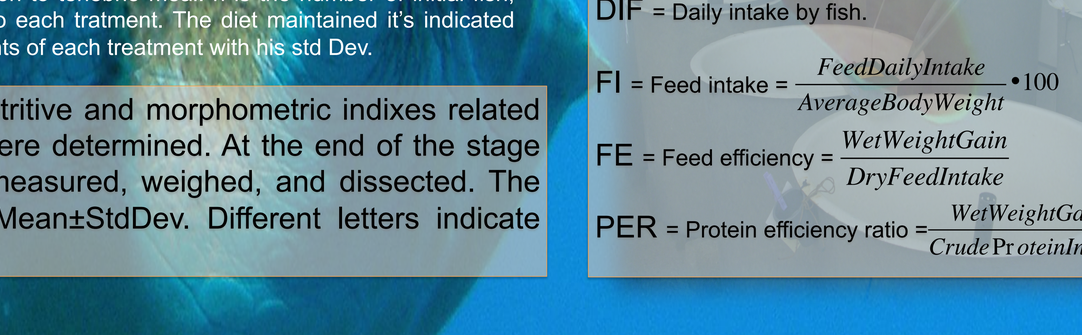
- No statistics differences were found among the treatment for the morphometrics indexes and condition factor.
- Fish fed meal insect have lower growth, however, the growth performance (*Table II*) dosen't show significant differences between I-C fish and C-C fish. I-C fish show a compensatory growth at have been fed with TM previously and after with a classic diet.

Table II.

	C-C	C-II	I-C	I-II
IBW	6.08 ± 2.89	6.01 ± 2.77	5.47 ± 2.29	5.43 ± 2.49
FBW	28.30 ± 9.55 a	23.60 ± 7.53 b	28.85 ± 8.86 a	24.30 ± 7.69 b
IBL	7.18 ± 1.19	7.15 ± 1.13	6.97 ± 0.97	6.95 ± 1.09
FBL	11.52 ± 1.49 a	11.01 ± 1.23 b	11.70 ± 1.21 a	11.17 ± 1.19 ab

- The DIF in fish fed with TM is higher than fish fed FM at the end of the 2nd stage.
- Any significative difference was found in SGR and FI in the four groups, but fish fed with TM at the end of the experiment show worse indexes of FE and PER respect C-C and I-C fish.

Graphic 3.



DISCUSSION

- The percentage of ingest shows a good acceptation of TM, however siginificant differences found in nutritional indexes studied, except SGR and FI, between the groups fed with FM or TM during the second stage, suggest a lower dry matter digestibility in Tenebrio meal compared to fish meal due to substances such as chitin.
- The improvement in I-C fish in all nutritive indexes front of C-C fish shows that could be an alternative to the traditional food for fish.
- The following investigations should continue in the search of new insects to achieve better nutritional indexes.

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