

# Effect of oxygen level and dietary composition on growth performance and intestinal morphology in Nile Tilapia (*Oreochromis niloticus*)

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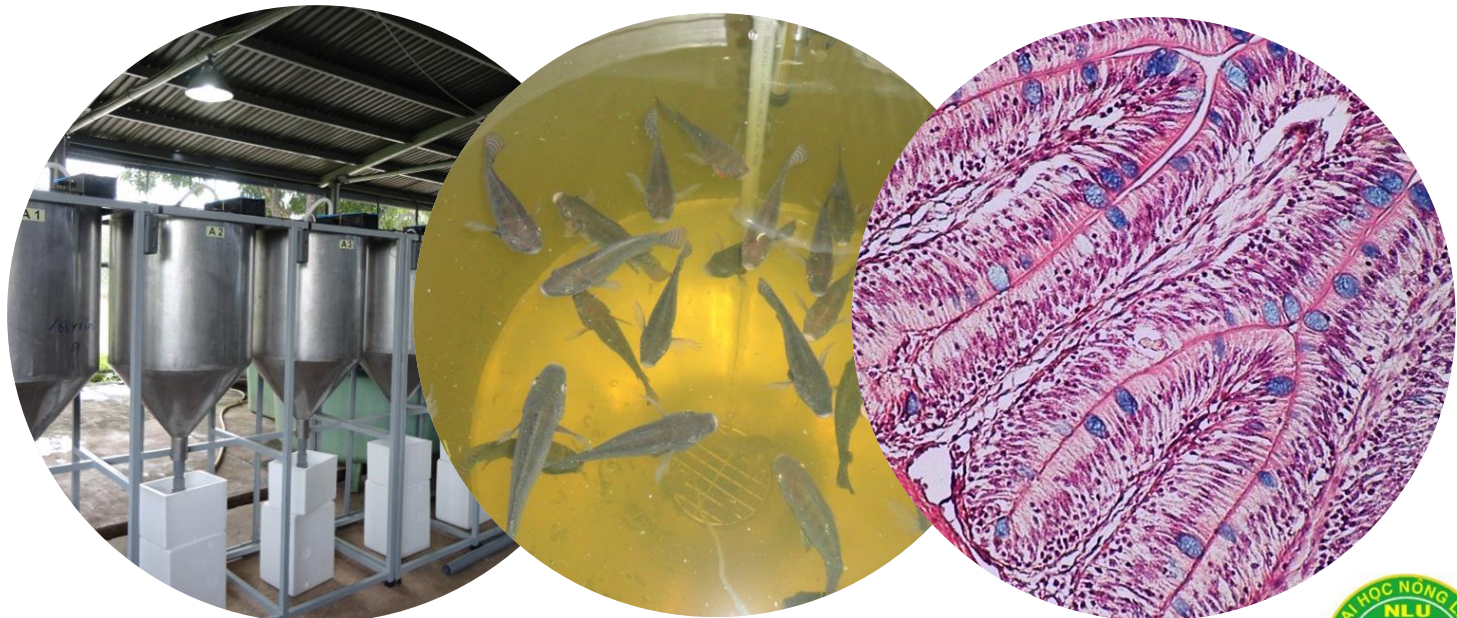
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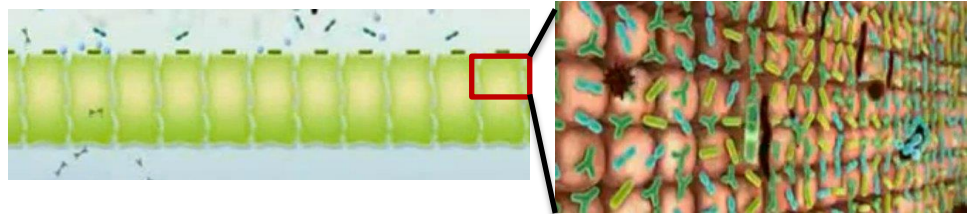
23 October 2015



# Outline

## 1. Introduction

- \* Gut health overview
- \* Hypothesis and objectives



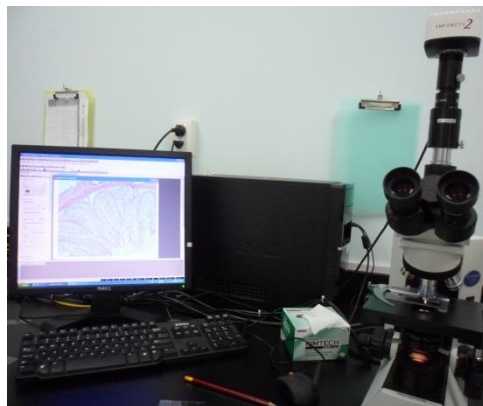
## 2. Materials and Methods



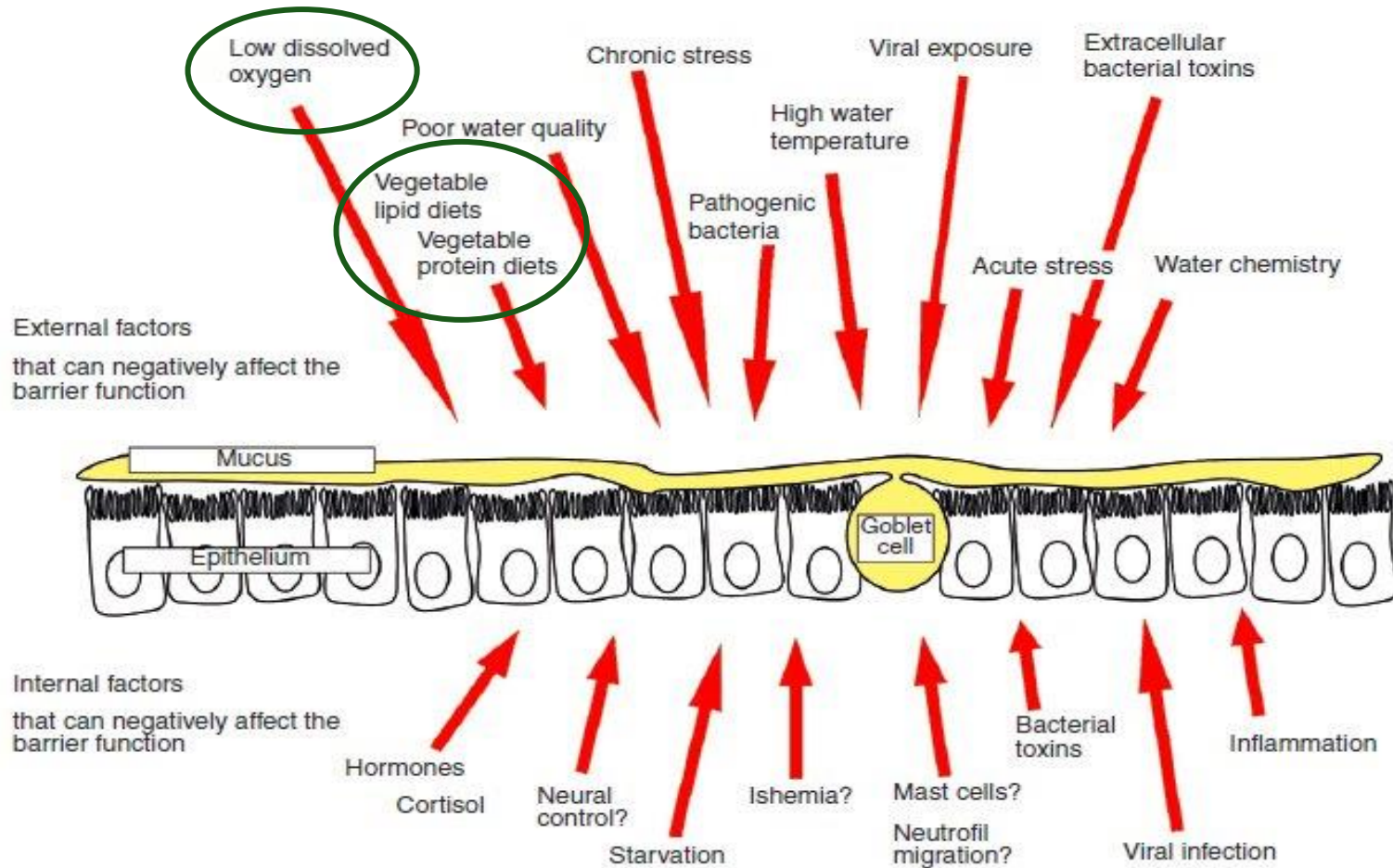
## 3. Results and Discussions



## 4. Conclusions

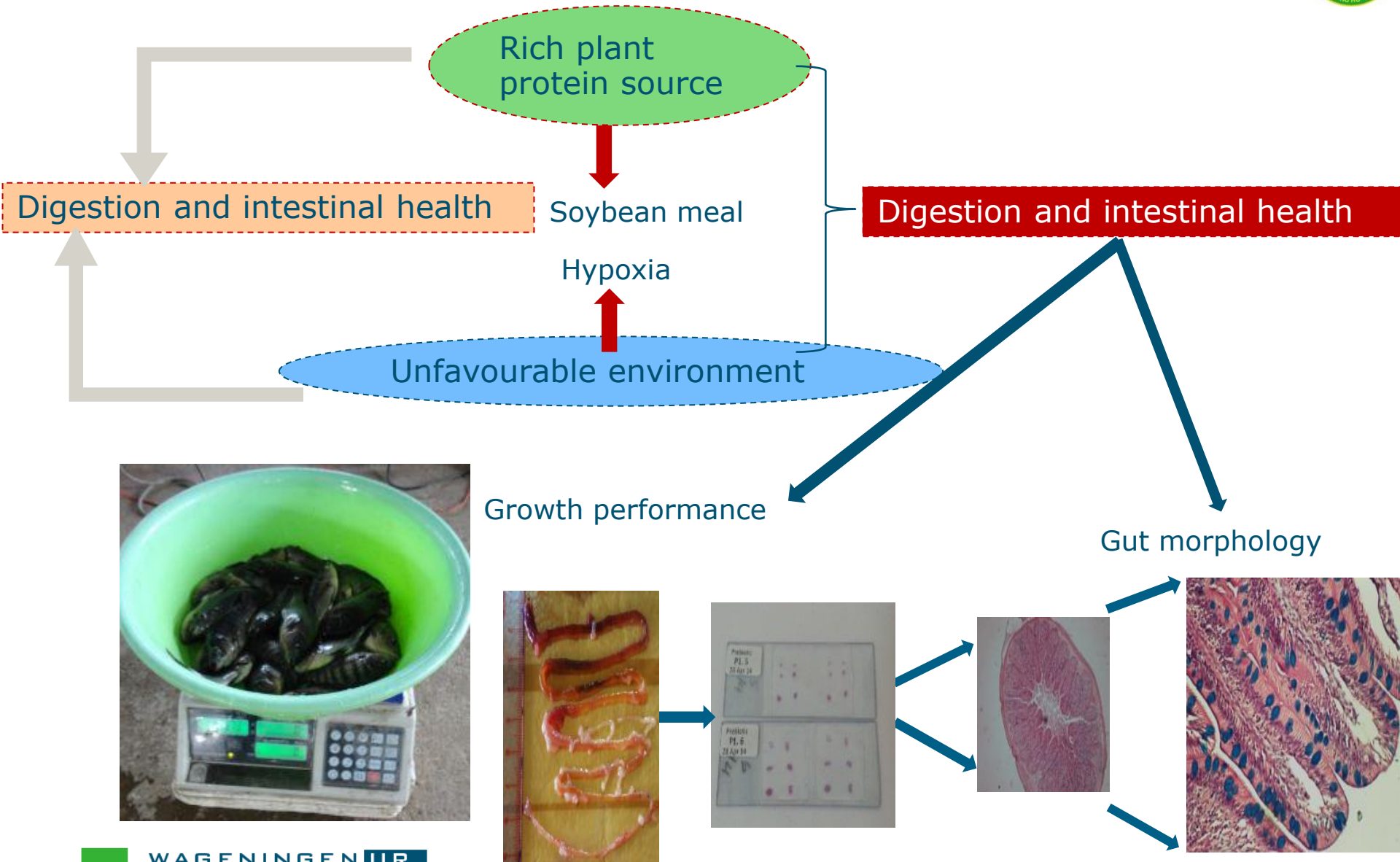


# Introduction: gut health overview





# Introduction: Hypothesis and Objectives



# Introduction: Aim of the study

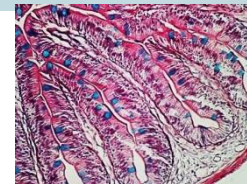


Soy bean meal



Hypoxia

Rich plant diet in combination with low oxygen level will disturb growth performance and gut morphology of Nile Tilapia



# Materials and Methods



| DO           | Normoxia  | Hypoxia   |
|--------------|-----------|-----------|
| ppm          | 6.9 ± 0.2 | 3.5 ± 0.4 |
| % saturation | 80        | 40        |

- 30 Nile Tilapia (23 g)
- Fed 3% body weight for 8 weeks



- 2 diets x 2 oxygen levels x 3 triplicate tanks

| Ingredient(%)  | Diets         |            |
|--|---------------|------------|
|  | “Control” (C) | “Test” (T) |
| Fish meal  | 20            | -          |
| Soybean meal   | 21.3          | 54.5       |
| Rice bran  | 18            | 10         |
| DDGS*  | 20            | 10.7       |
| Cassava  | 13            | 13         |
| <i>Analysed nutrient content on DM basis (g kg<sup>-1</sup>)</i> |               |            |
| Dry matter (DM; gkg <sup>-1</sup> diet)                          | 924           | 930        |
| Crude protein  | 302           | 314        |
| Crude fat  | 81            | 86         |
| Total carbohydrates <sup>1</sup>                                 | 517           | 518        |
| Ash  | 100           | 82         |
| Phosphorus   | 11            | 10         |
| Chromic oxide  | 16            | 15         |

<sup>1</sup>Calculated as, total carbohydrates = 100 – (crude protein + crude fat + ash)

\*DDGS: distillers dried grains with soluble

\*\*DCP: di-calcium phosphate

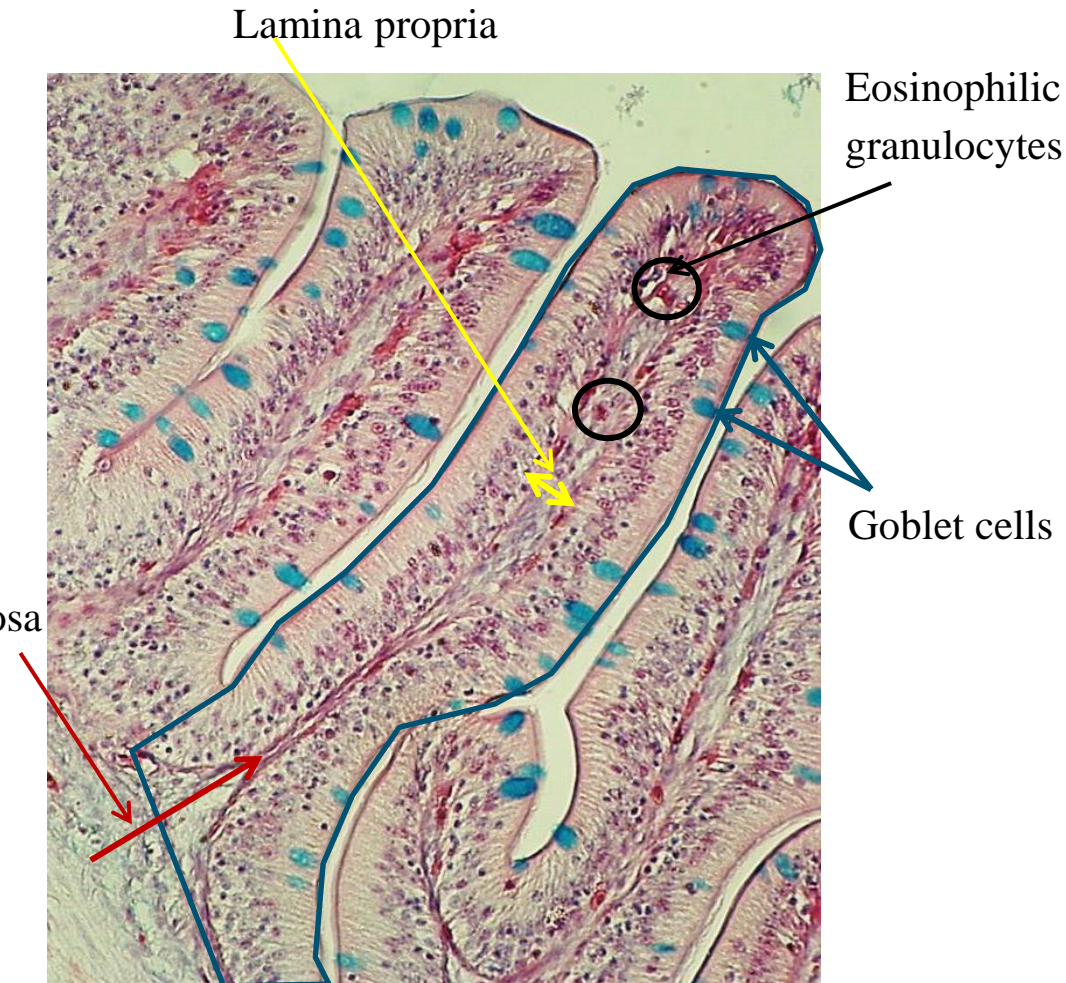


# Materials and Methods: measurement of gut morphology



Measurable and countable method are extended from semi-quantitative method developed at Wageningen University (Urán *et al.* 2008)

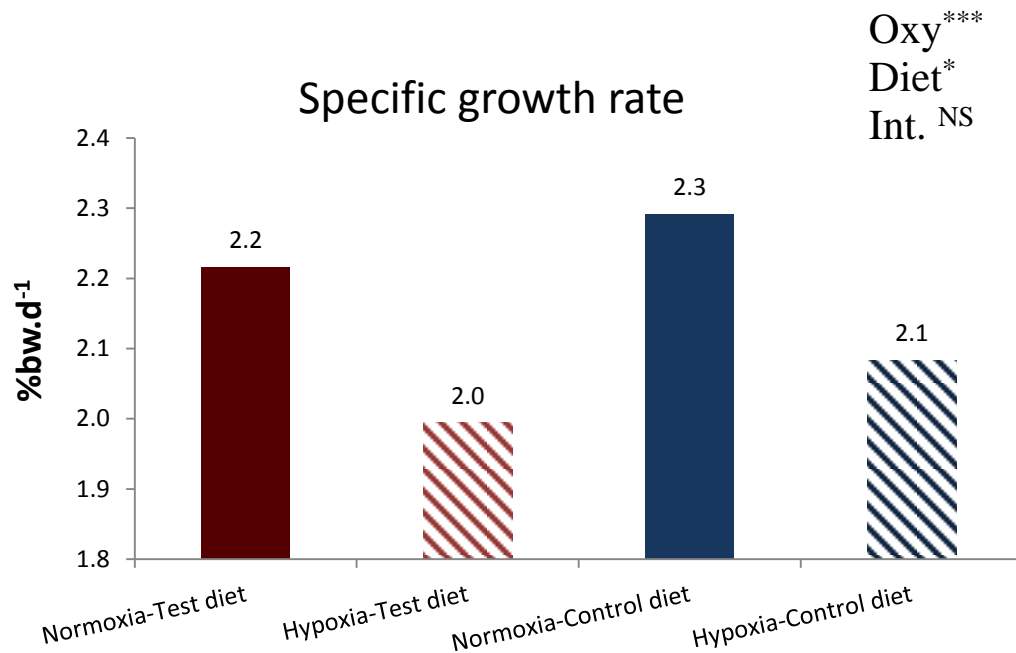
1. Number of goblet cell (GC) in  $\mu\text{m}^2$  of villi
2. Number of eosinophilic granulocytes (EG) in  $\mu\text{m}^2$  of villi
3. Thickness of lamina propria in  $\mu\text{m}$
4. Thickness of submucosa in  $\mu\text{m}$



# Results: Growth performance



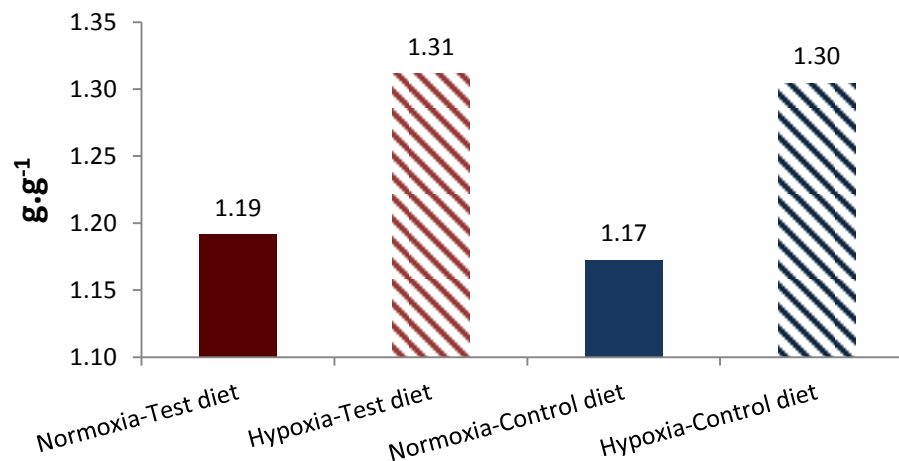
Specific growth rate



Feed intake = 2.4 %bw.d<sup>-1</sup>

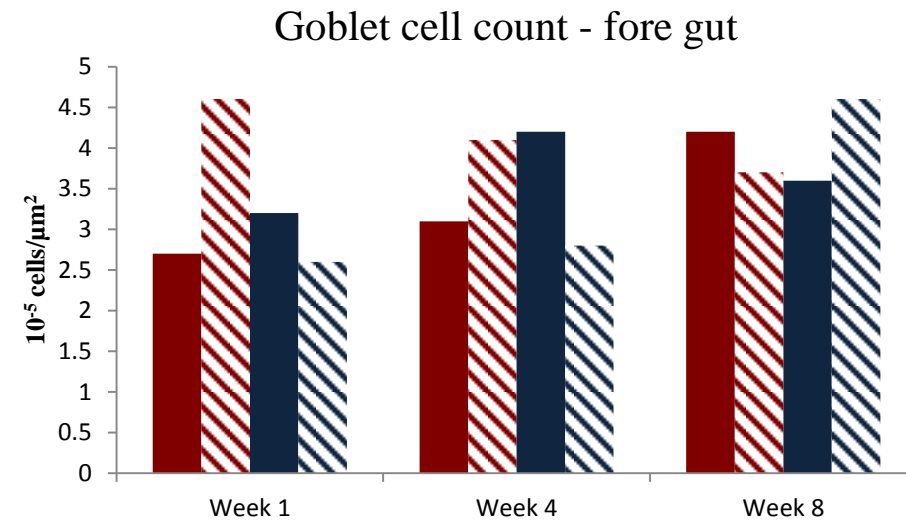
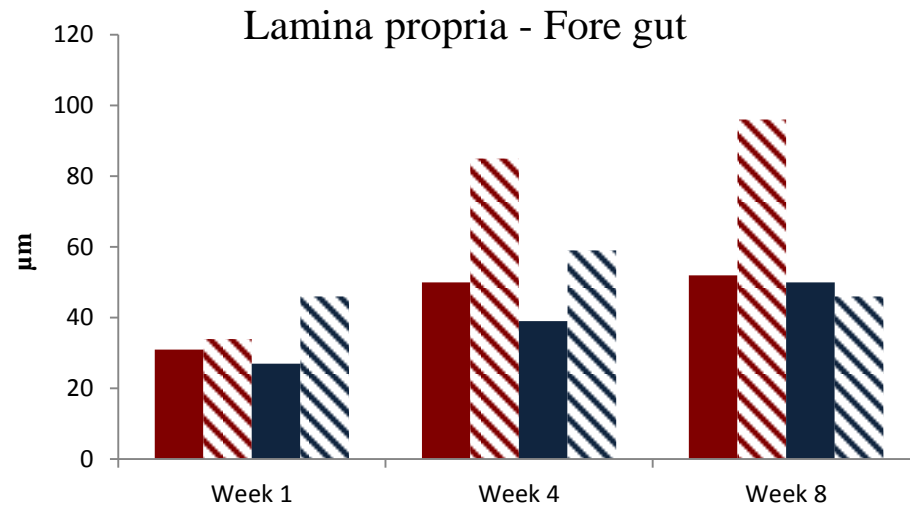
Oxy<sup>\*\*</sup>  
Int. NS

Feed conversion ratio



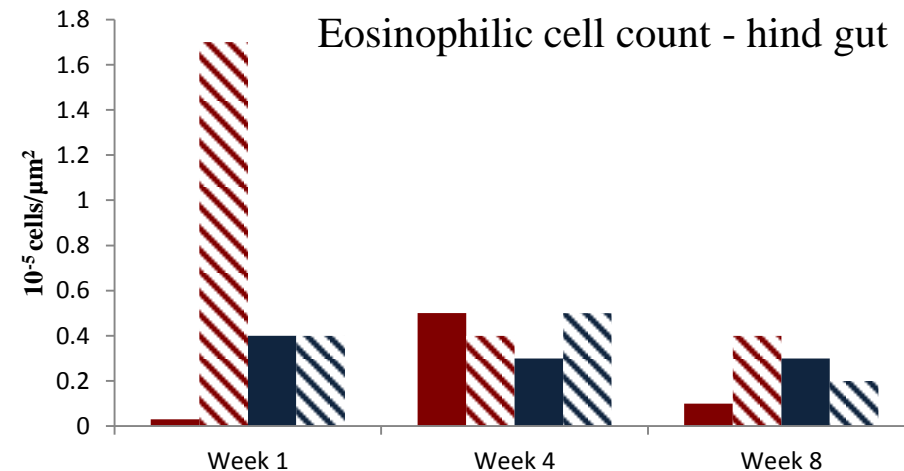


# Results: Gut morphology – Time effects



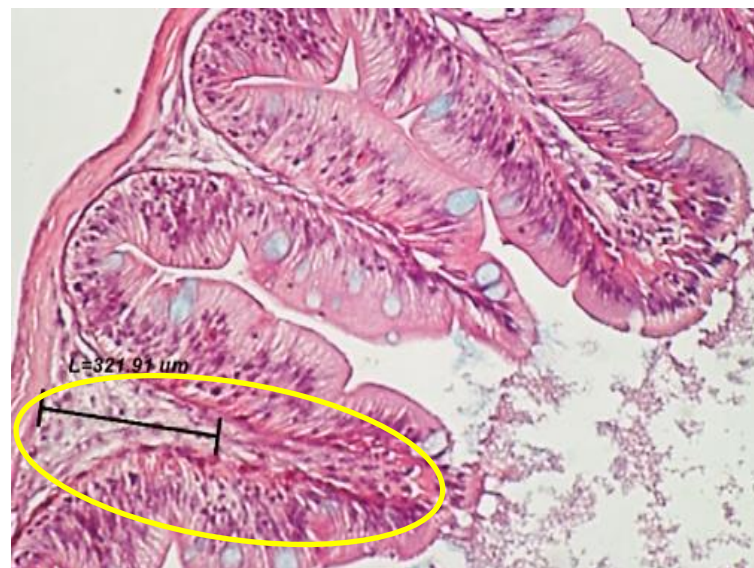
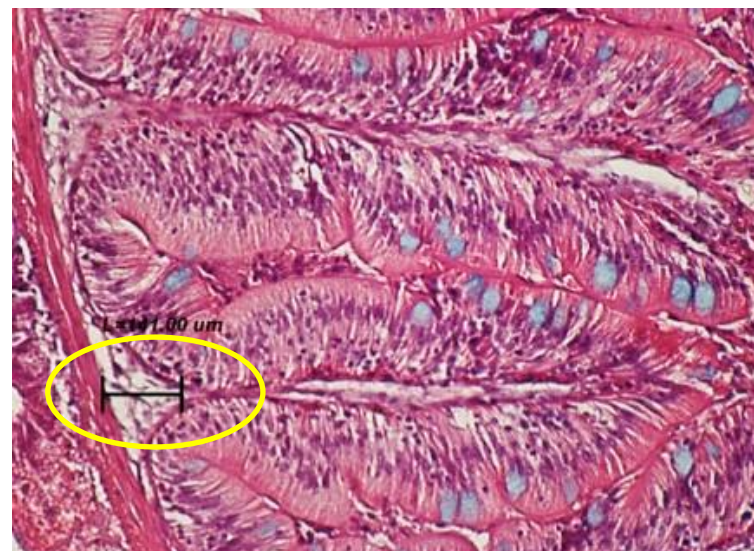
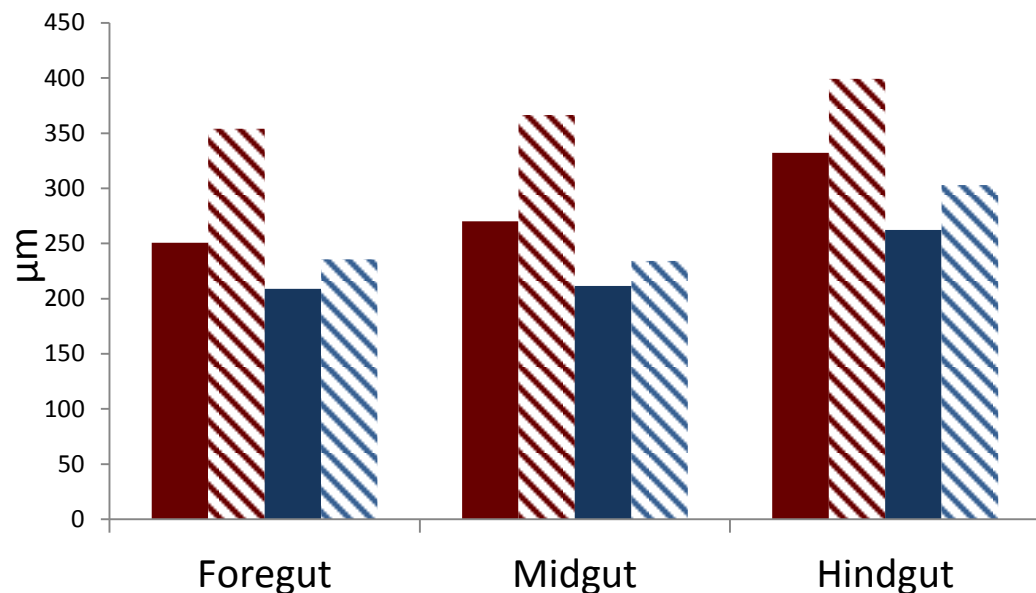
Time effects  
(Week x Diet x Oxy)

|                           | Foregut | Midgut | Hindgut |
|---------------------------|---------|--------|---------|
| Submucosa                 | -       | -      | -       |
| Lamina propria            | *       | -      | -       |
| Goblet cells              | *       | -      | -       |
| Eosinophilic granulocytes | -       | -      | *       |



# Results: Gut morphology – Main effects

## Submucosa

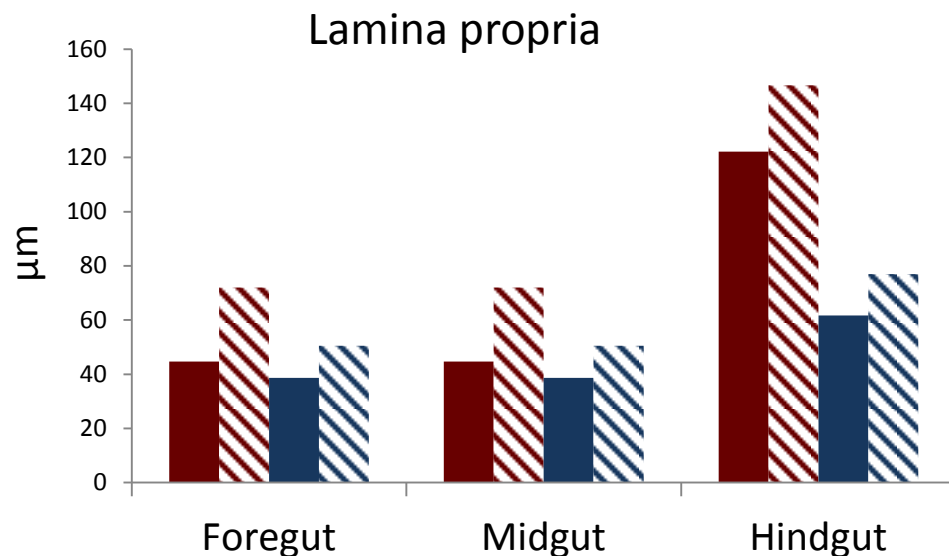


Hypoxia + Test diet → the largest thickness of SM

| Main effects | Oxy | Diet | Oxy x Diet |
|--------------|-----|------|------------|
| Foregut      | **  | ***  | *          |
| Midgut       | *   | ***  | -          |
| Hindgut      | **  | ***  | -          |



# Results: Gut morphology – Main effects



Hypoxia + Test diet → the largest thickness of LP

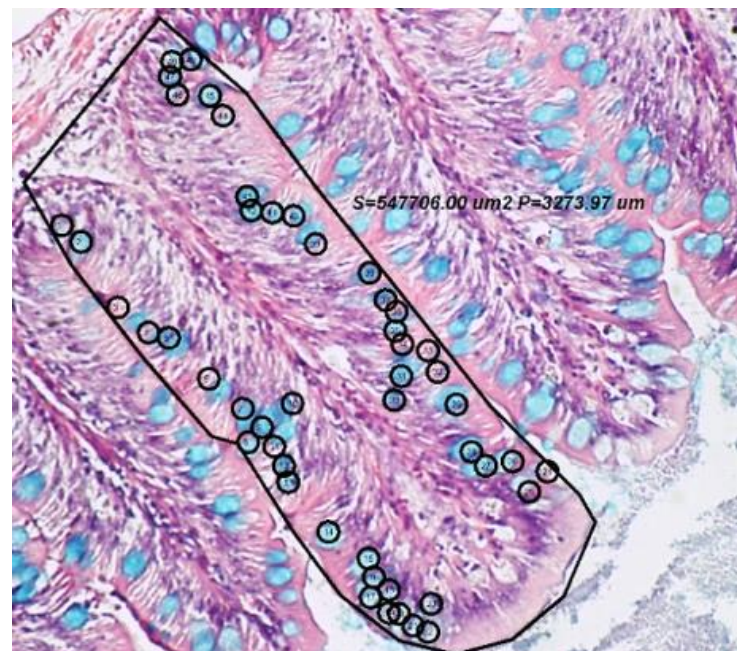
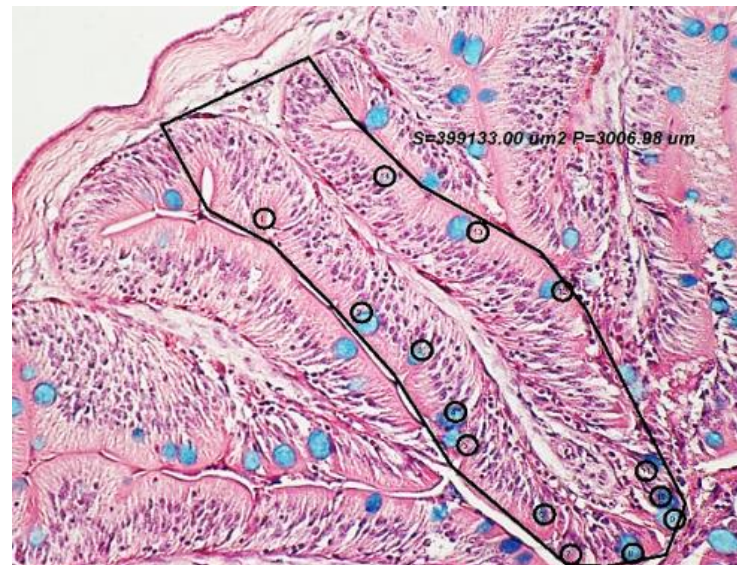
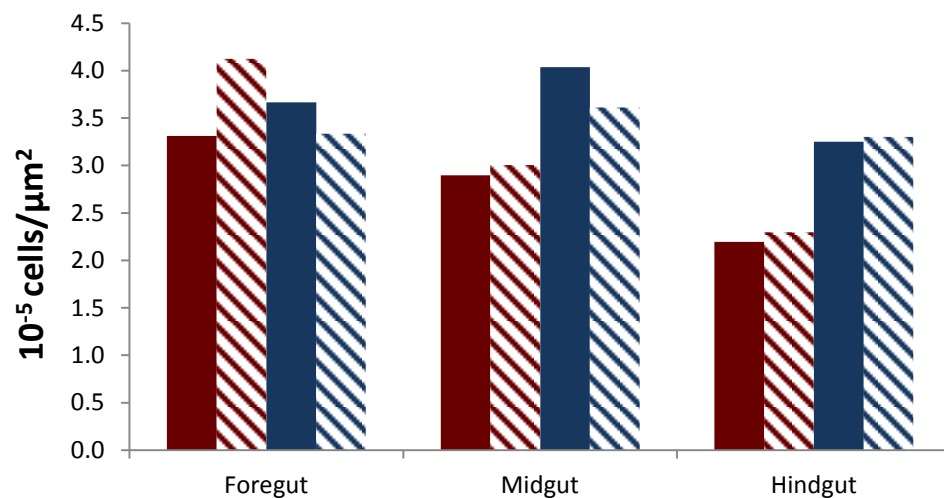
| Main effects | Oxy | Diet | Oxy x Diet |
|--------------|-----|------|------------|
| Foregut      | *** | **   | -          |
| Midgut       | **  | ***  | -          |
| Hindgut      | -   | ***  | -          |





# Results: Gut morphology – Main effects

Goblet cells



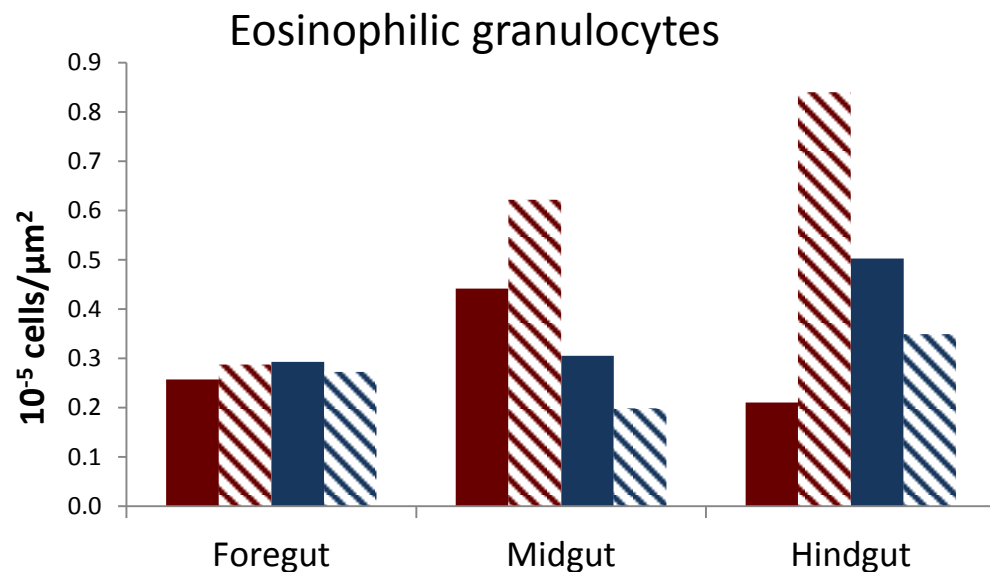
| Main effects | Oxy | Diet | Oxy x Diet |
|--------------|-----|------|------------|
|--------------|-----|------|------------|

|         |   |   |   |
|---------|---|---|---|
| Foregut | - | - | - |
|---------|---|---|---|

|        |   |   |   |
|--------|---|---|---|
| Midgut | - | * | - |
|--------|---|---|---|

|         |   |    |   |
|---------|---|----|---|
| Hindgut | - | ** | - |
|---------|---|----|---|

# Results: Gut morphology – Main effects



| Main effects | Oxy | Diet | Oxy x Diet |
|--------------|-----|------|------------|
| Foregut      | -   | -    | -          |
| Midgut       | -   | *    | -          |
| Hindgut      | -   | -    | **         |



# Conclusions



Growth performance in term of final body weight, specific growth rate, feed conversion ratio were significant worse for fish fed with the rich-plant diet and this was further worsened under hypoxia

The rich-plant diet in combination with hypoxia induced morphological signs of intestinal disorders:

- Increasing the thickness of SM and LP at foregut
- Increasing the number of GC and EG at mid and hindgut

Under hypoxia condition and feeding rich-plant diet, tilapia did not show recovery signs in term of LP and GC. However, EG may indicate that tilapia can adapt to rich-plant diet feeding to reduce allergy response



# Thank you

