



University of Idaho

College of Agricultural
and Life Sciences

Project Report : November 2023

***PROJECT TITLE: ENHANCING THE SOYBEAN MEAL
UTILIZATION IN ATLANTIC SALMON DIET VIA USING
INSECT MEAL AS A COMPLEMENTARY INGREDIENT***

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CHALLENGES IN AQUACULTURE



Microbial disease

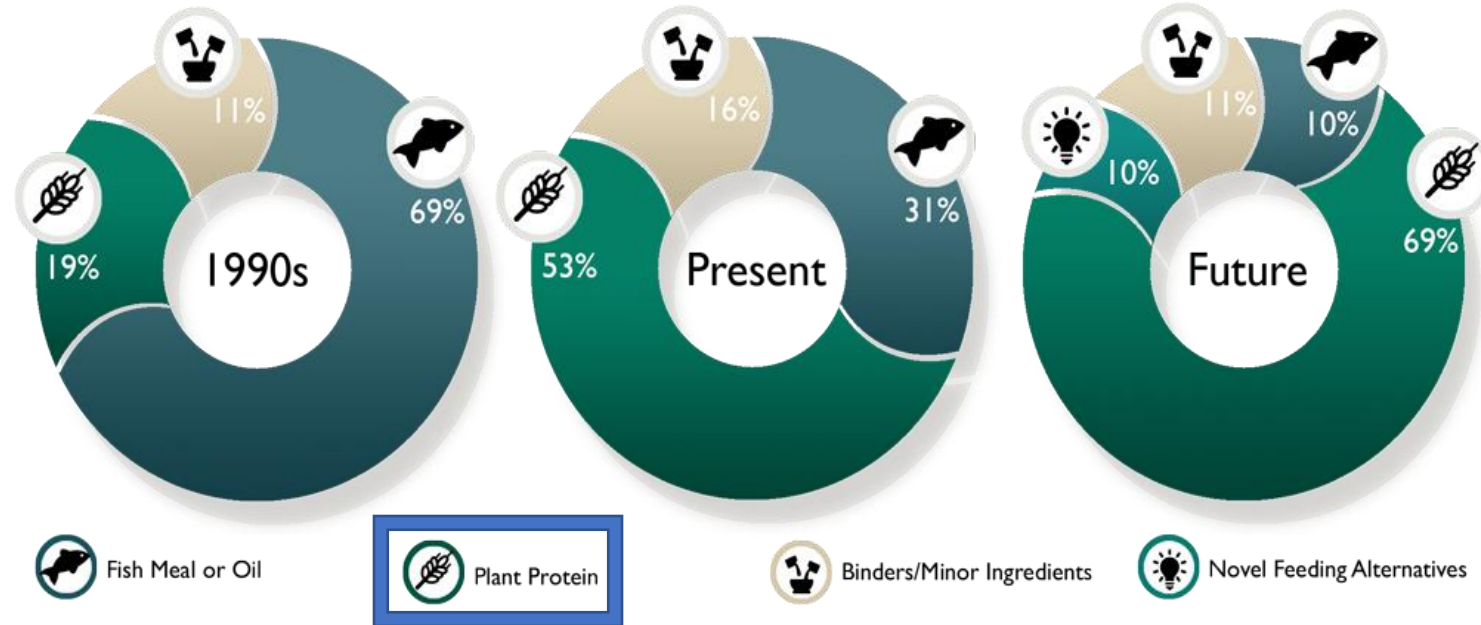
- Lack of knowledge
- Restricted antibiotic use
- \$6B annual loss



Fish Meal/Oil

- Good AA profile
- Excellent digestibility
- No antinutritional factors/enteritis
- But:
- Unsustainable
- Costly

AQUAFEED COMPONENTS OVER TIME



3³



POTENTIAL AQUAFEED SOLUTIONS



SOYBEAN MEAL

- Less costly than fishmeal
- Good protein source
- Sustainable
- BUT:
- Antinutritional factors, enteritis
- Lysine and Methionine deficient



INSECT MEAL

- High protein/lipid quantity
- More sustainable than fishmeal
- High yield/acre
- BUT:
- Low digestibility of chitin
- Low calcium and phosphorus levels
- Costly

Black Soldier fly (*Hermetia illucens*) Larvae in Aquafeed

- Poses no disease threat
- High protein content
- Converts organic waste into biomass
- Similar aa profile to fish meal
- Possible antimicrobial properties



	Lauric acid (12:0)	palmitic acid (16:0)	Linoleic (18:2 n6)	Linolenic (18:3 n3)
Superworm	nd	52.80	32.90	1.10
Mealworm, larvae	0.60	22.90	34.80	1.40
Mealworm, adult	nd	8.50	13.70	0.40
Waxworm	nd	79.60	15.20	1.10
Silkworm	nd	1.70	3.50	1.40
Cricket, adult	nd	0.90	22.90	0.60
Cricket, nymph	nd	0.30	11.00	0.40
Earthworm	na	na	na	na
Black soldier fly, larvae	21.70	1.10	3.00	0.20

<https://www.enviroflight.net/products/enviro-bug>

Unanswered questions

- What are the effects of complementing salmonid diets with insect meal?
- How does whole insect larvae perform as a complementary ingredient?
- **WHY ATLANTIC SALMON?**
 - Economic value



Objectives

- Evaluate the effects of using whole insect black soldier fly meal as a complementary ingredient in soybean-based diets for Atlantic salmon on:
 - Growth performance
 - Feed efficiency
 - Gut histology

Experimental design

Feeding Trial – 12 weeks

Diets: 7 isonitrogenous (40% CP) and isolipidic (20% CL)

1. Control feed - 0% SBM + 30% fishmeal (FM)
 2. 30% SBM + 10% FM
 3. 30% SBM + 10% FM + 5% BSFL
 4. 30% SBM + 10% FM + 10% BSFL
 5. 40% SBM + 10% FM
 6. 40% SBM + 10% FM + 5% BSFL
 7. 40% SBM + 10% FM + 10% BSFL
- Completely Randomized Design to assign diets to tanks
 - ***BSFL**- whole insect black soldier fly larvae
 - 3 tanks/treatment, 30 fish/tank

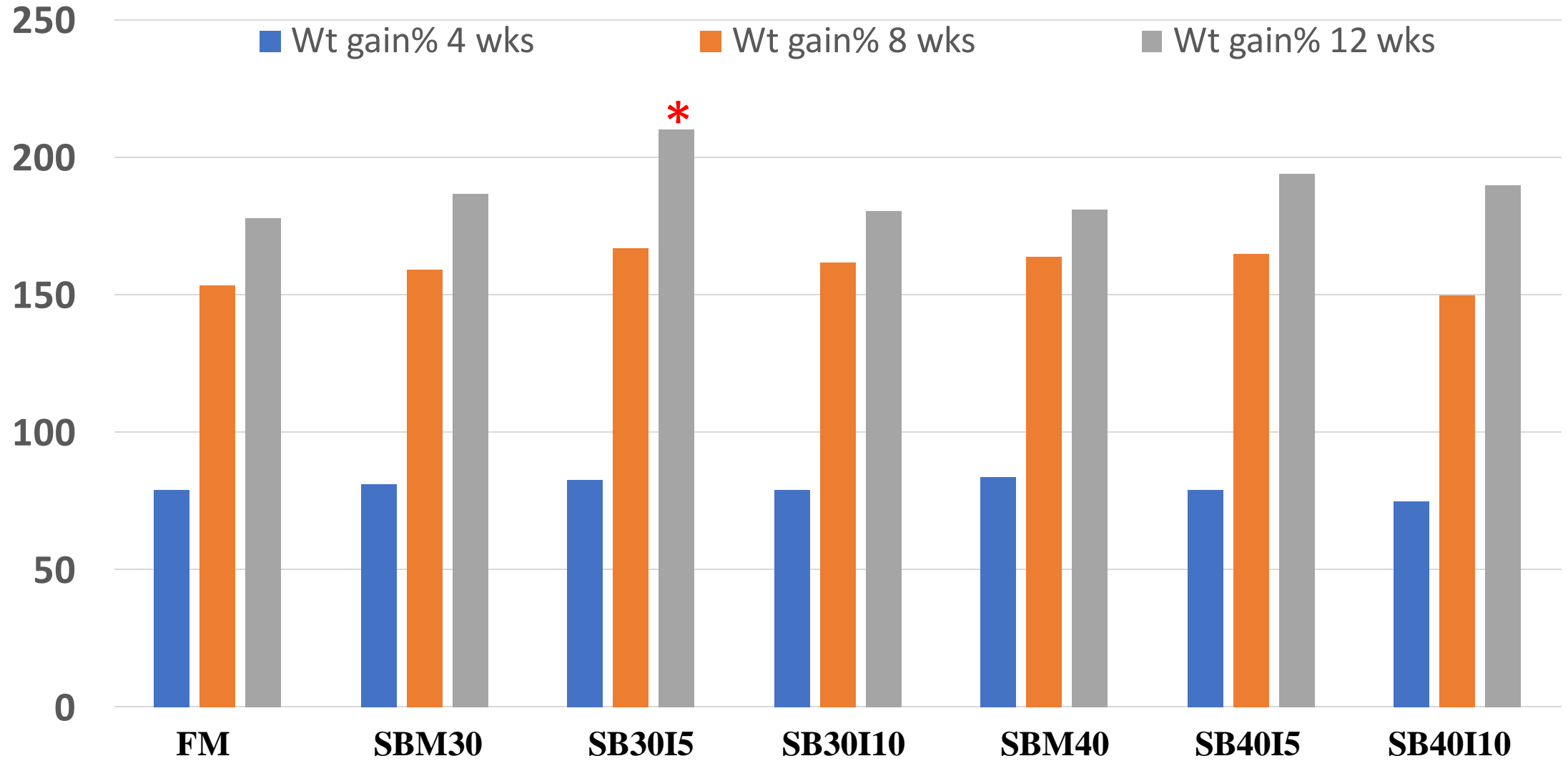


EXPT DESIGN

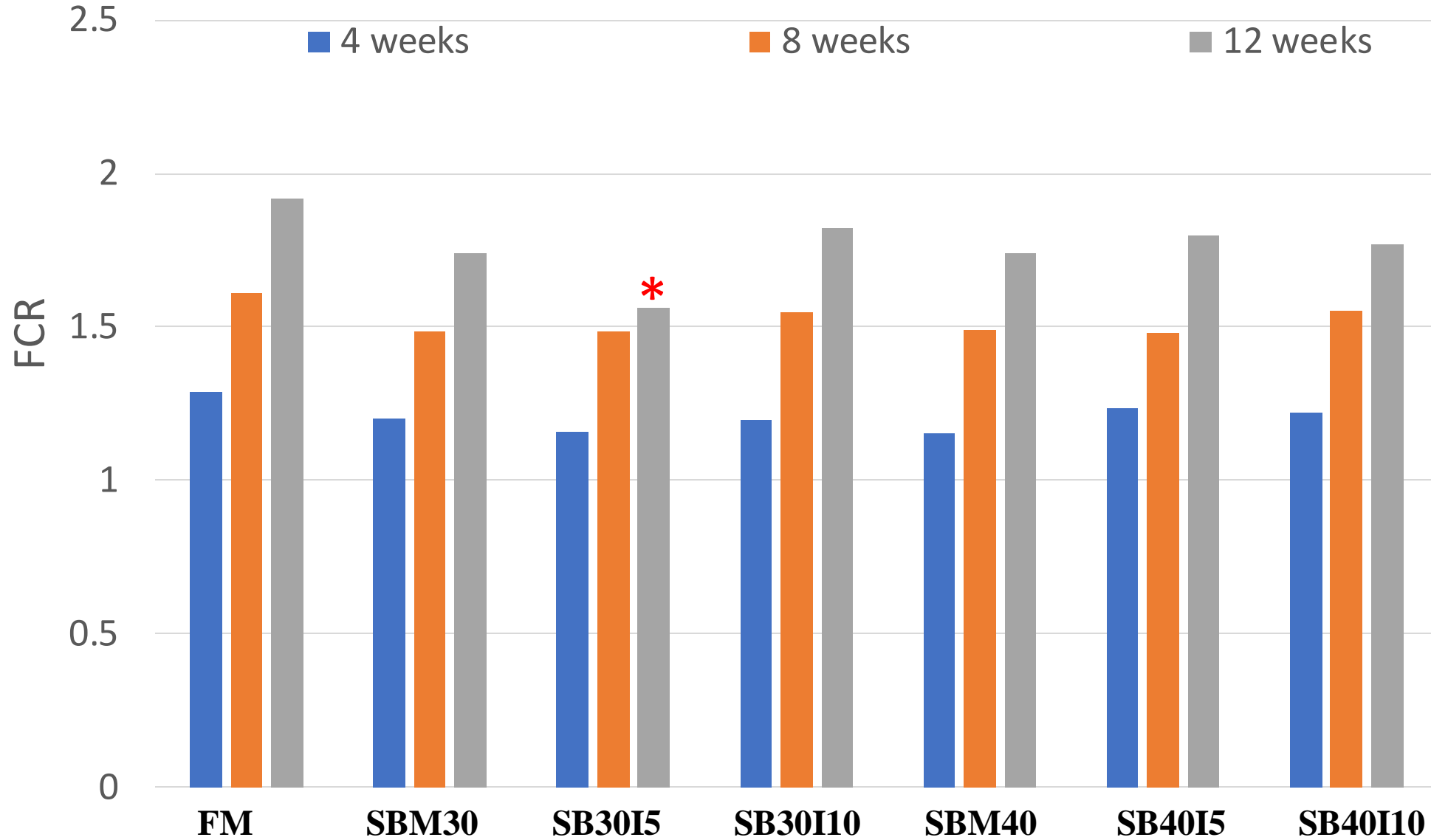
- Initial weight: 15 g
- Fed to satiation 2 times daily, 6 days/week for 12 weeks
- Samples every 4 weeks, 3 total
- 3 fish/tank for histology and gene expression
- Gene expression - Distal intestine, liver, muscle tissue
- Histological evaluation of intestine



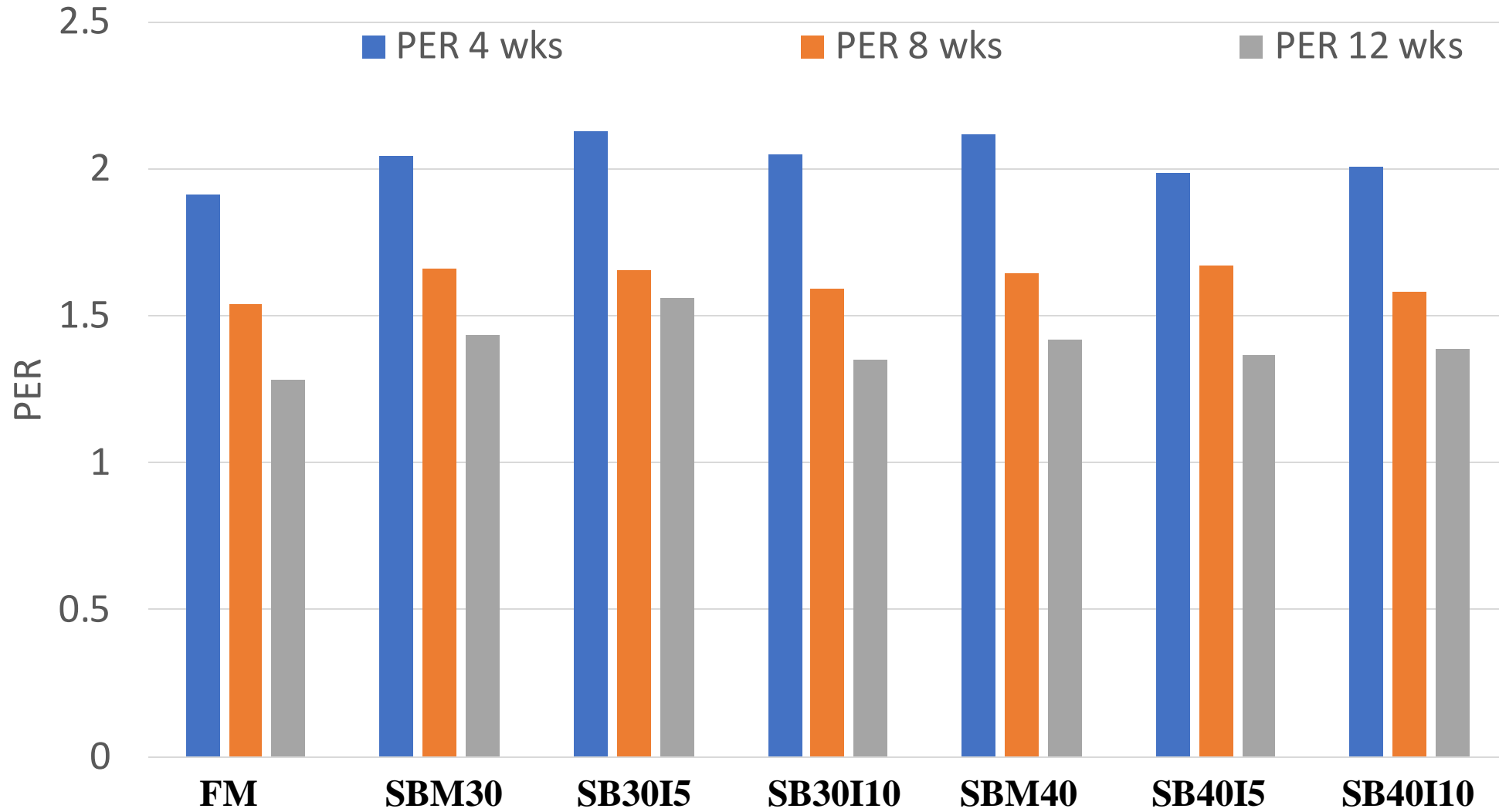
Percent Weight Gain – 12 weeks

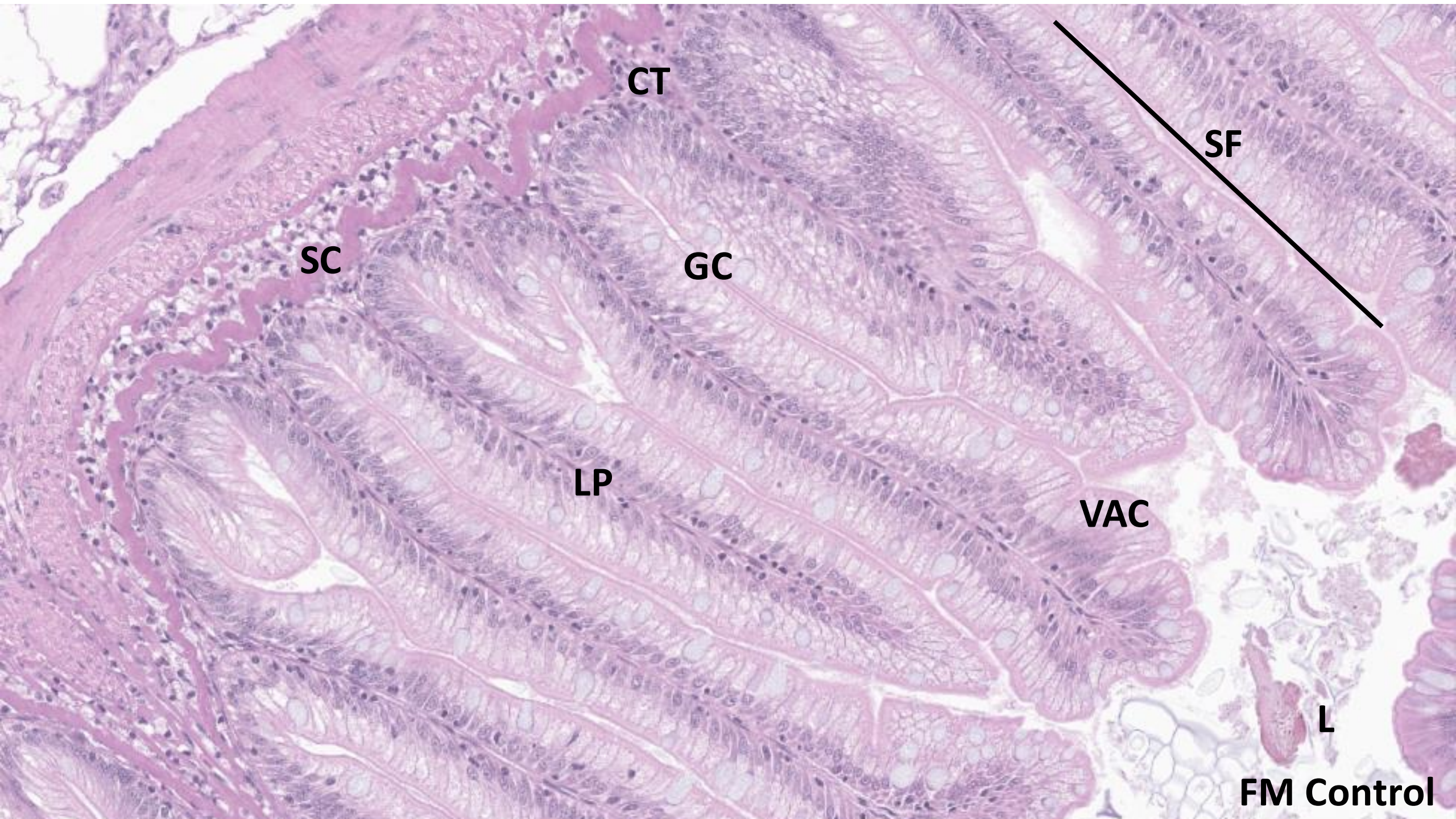


Feed Conversion Ratio

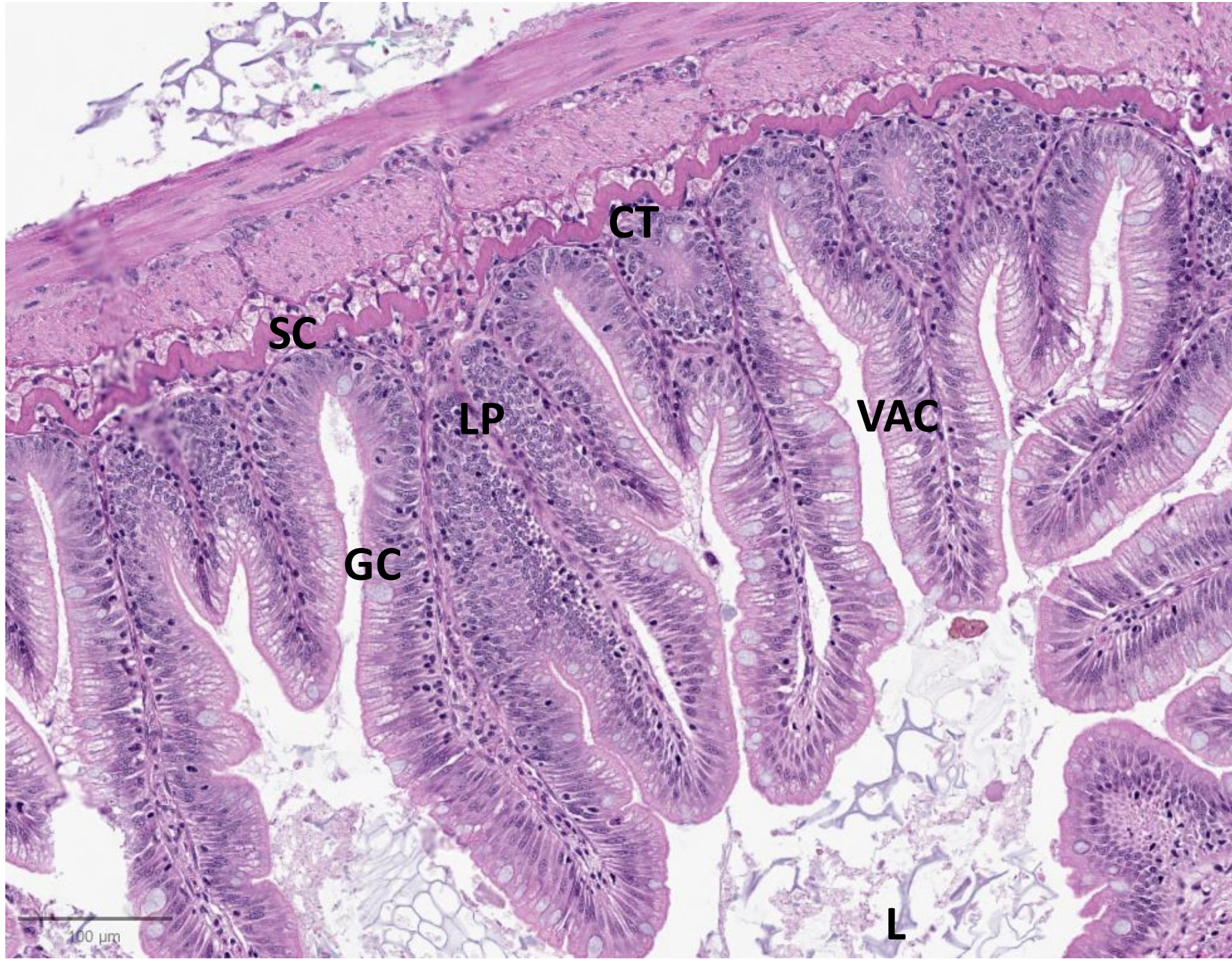


Protein Efficiency Ratio





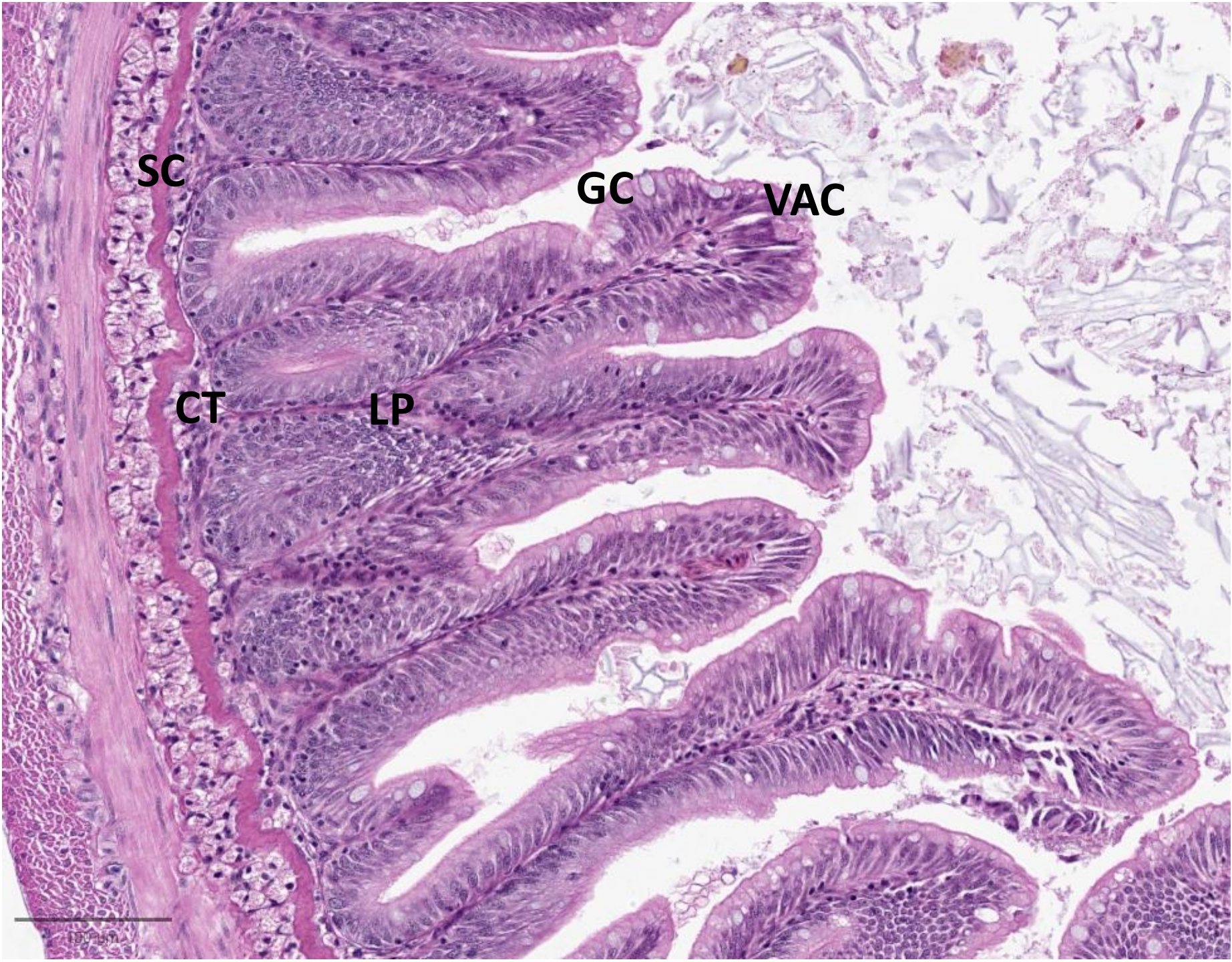
SBM30



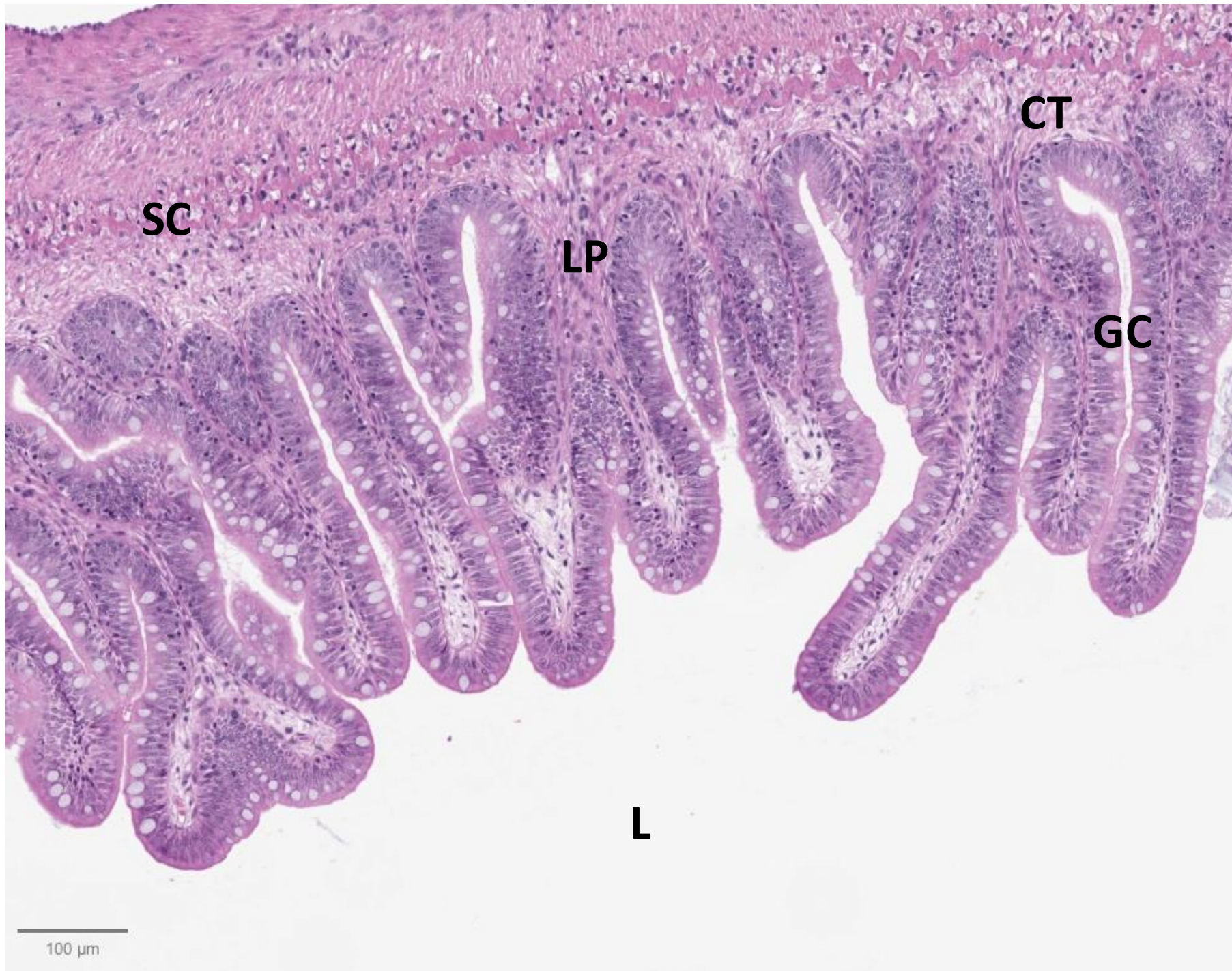
100 μm

L

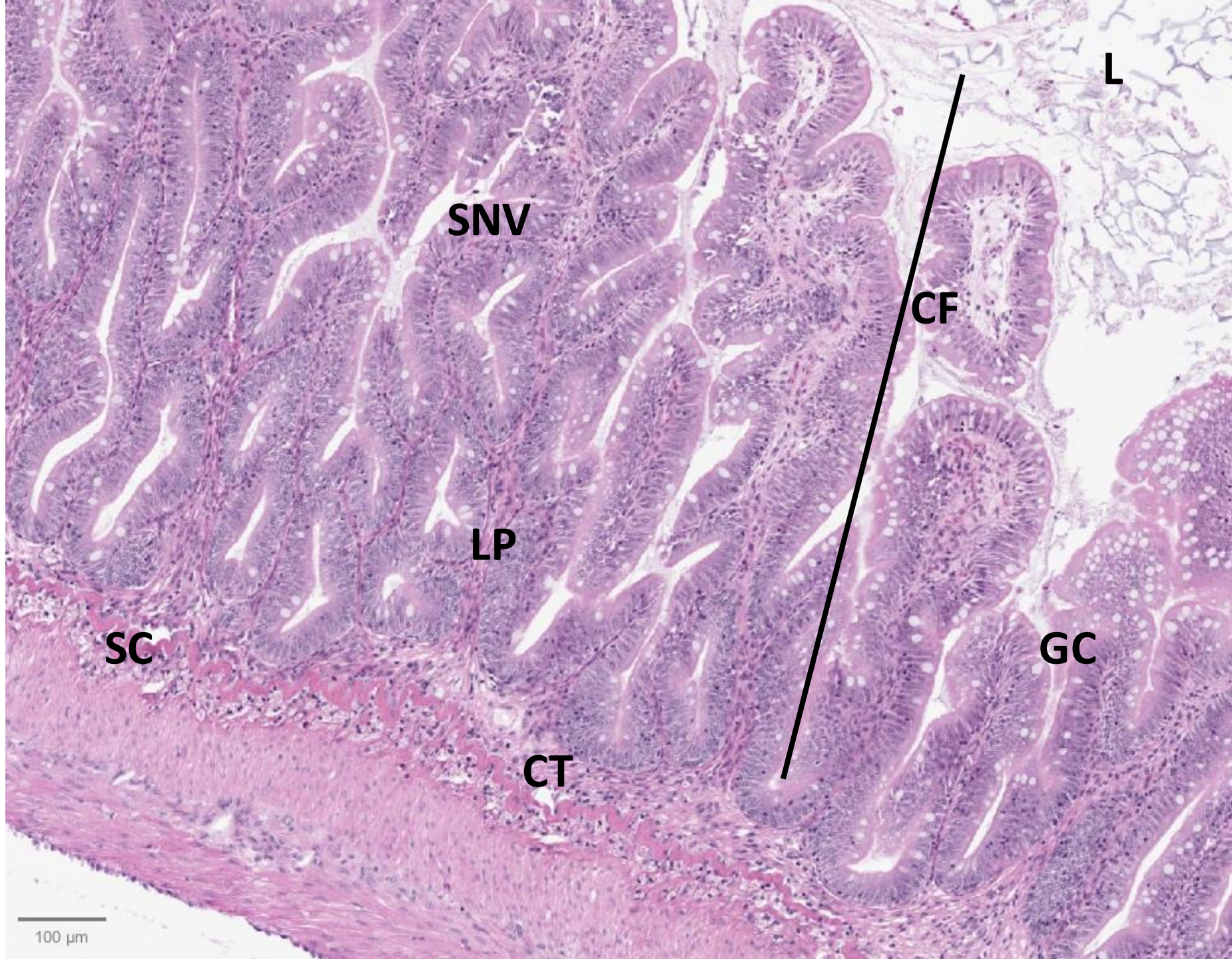
SBM 30 + I5



SBM 30 + I10



SBM 40



SNV

L

CF

LP

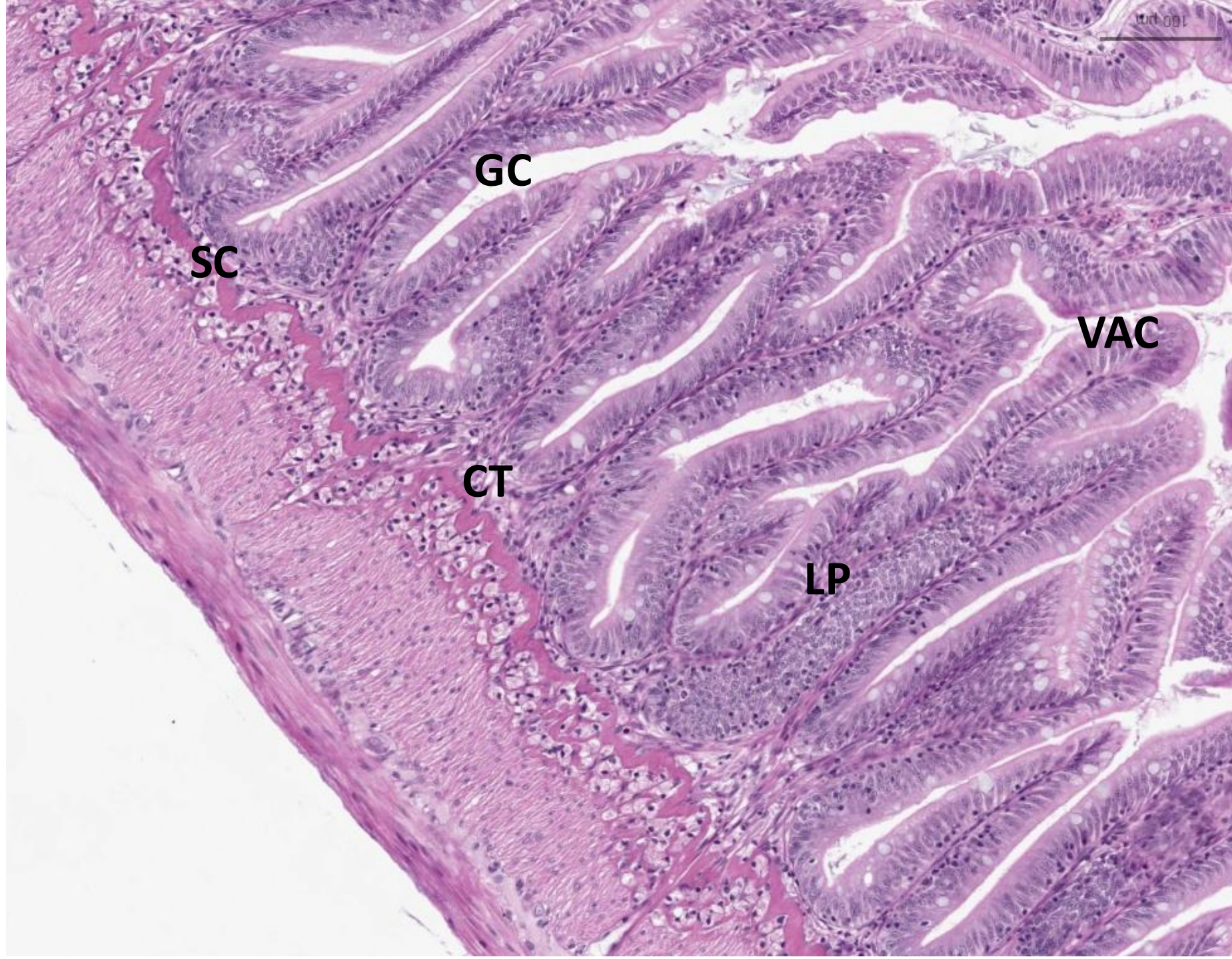
SC

GC

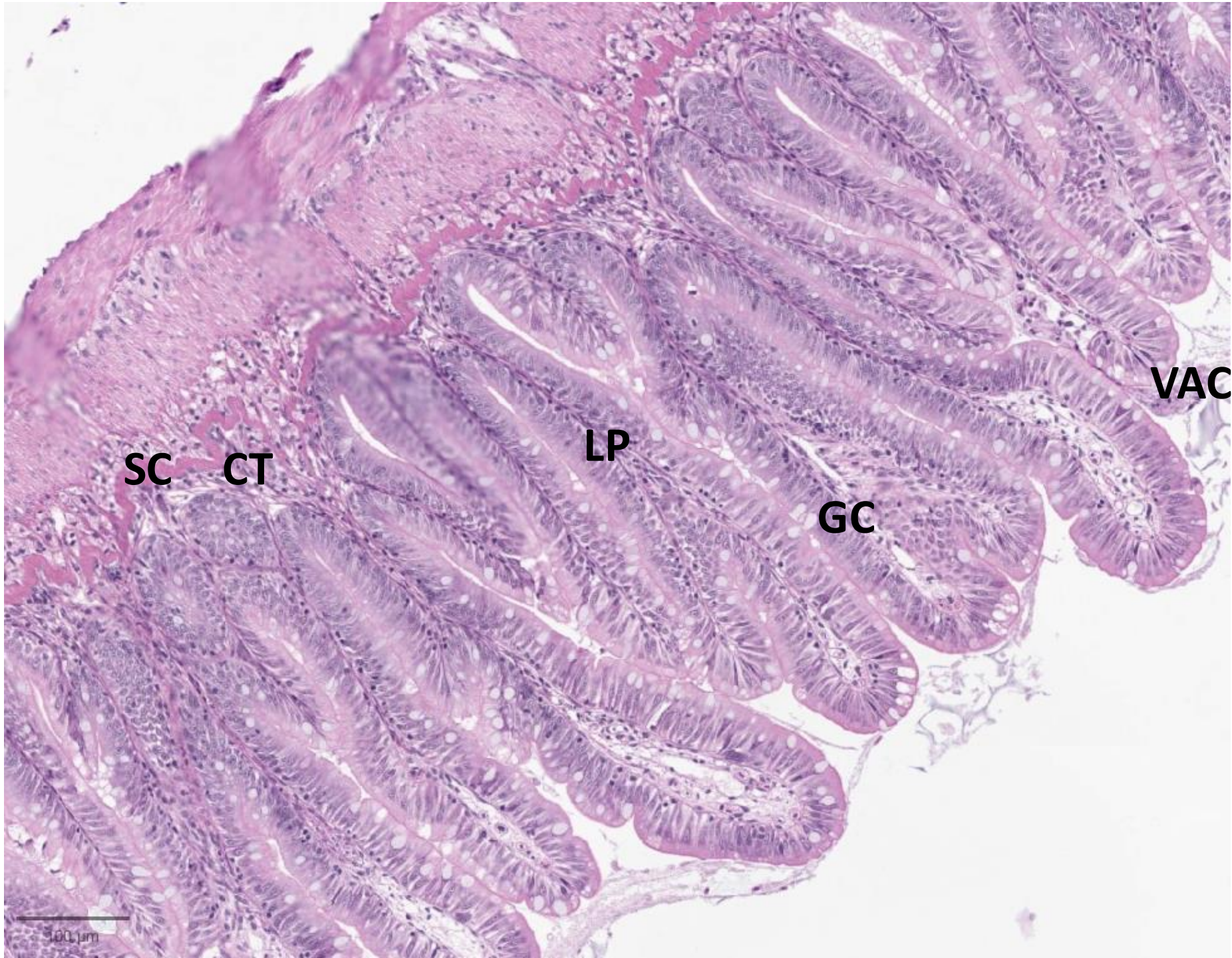
CT

100 μm

SBM 40 + I5



SBM 40 + I10



CONCLUSIONS

Dietary supplementation of whole black soldier fly larvae meal in soybean meal diets for Atlantic salmon:

- Improves growth performance
- Enhances soybean utilization
- Mitigates gut health/enteritis
- Provides an alternative dietary approach to improve utilization of feed ingredients in sustainable aquafeed

ACKNOWLEDGEMENTS



University of Idaho



AQUACULTURE AMERICA 2023



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THANK YOU

• QUESTIONS?