

Unlock the growth potential: The role of saponins in enhancing shrimp gut health



Agenda

1

- Gut health and the importance for performance improvement

2

- Saponins in Aquaculture

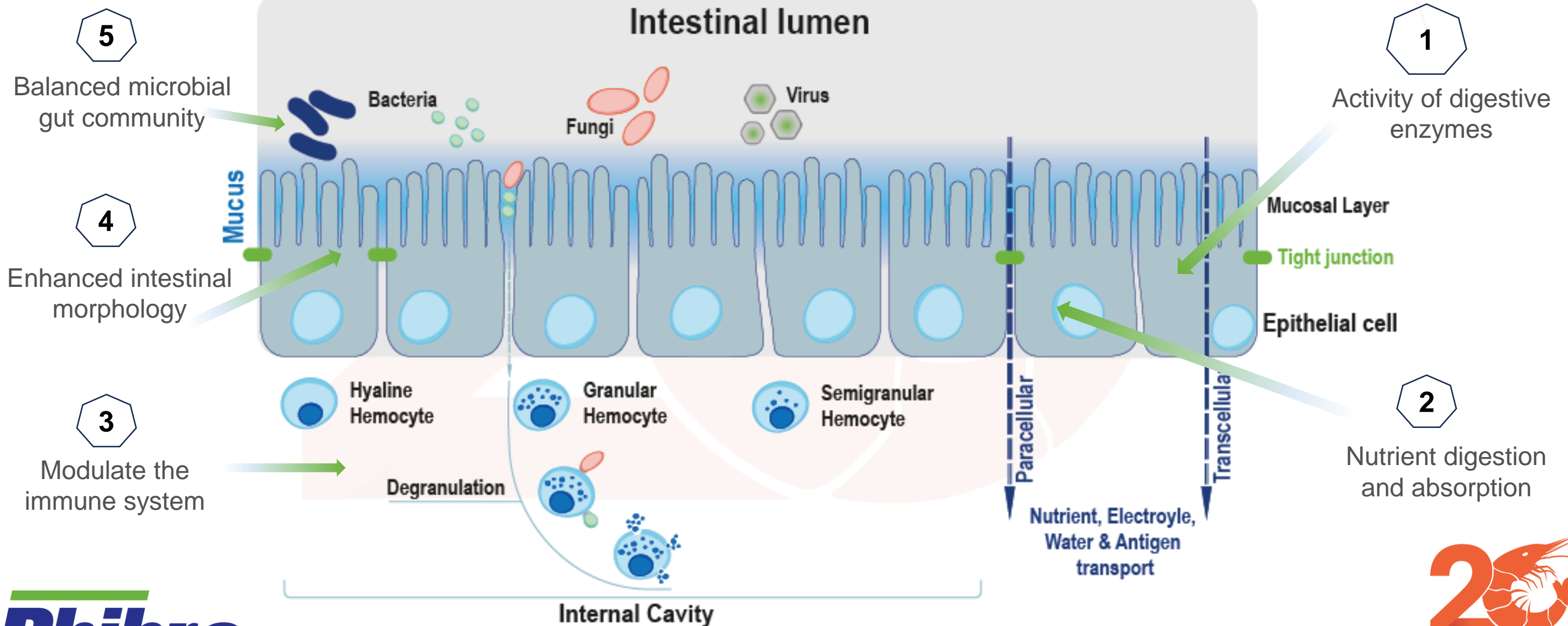
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- Influence of saponins on shrimp and fish gut health

4

- Conclusions

How can we improve gut health and functionality?



What are Saponins?

- Secondary plant compounds.
- Contain lipophilic part & hydrophilic sugar side chains.
- Can be found in several molecular forms.
- Known for their hemolytic and piscicidal effects.
- Can be found in several plant sources:
 - Ginseng
 - Quillaia
 - Yucca
 - Soy
 - Asparagus
 - Alfalfa



Literature review of benefit of Saponin in aquafeed

Research Article

The effects of *Yucca schidigera* and enzymes activities on growth performance and immune-oxidative status of Nile tilapia, *Oreochromis niloticus*

Quillaja saponaria and/or Yucca schidigera ameliorate water quality, growth performance, blood health, intestine and gills histomorphology of Nile tilapia, *Oreochromis niloticus*

Ahmed M. Abozeid¹ | Mohamed M. Abdel-Rahim² | Fatma Abouelenien³ | Amr Elshorbagy¹ | Reda A. Mohamed¹

The biological action of saponins in animal systems: a review

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Saponins are steroid or triterpenoid glycosides, common in a large number of plants and plant products that are important in human and animal nutrition. Several biological effects have been ascribed to saponins. Extensive research has been carried out into the membrane-permeabilising, immunostimulant, hypocholesterolaemic and anticarcinogenic properties of saponins and they have also been found to significantly affect growth, feed intake and reproduction in animals. These structurally diverse compounds have also been observed to kill protozoans and molluscs, to be antioxidants, to impair the digestion of protein and the uptake of vitamins and minerals in the gut, to cause hypoglycaemia, and to act as antifungal and antiviral agents. These compounds can thus affect animals in a host of different ways both positive and negative.

Saponins: Steroids: Triterpenoids: Biological activity

Research Article

The effects of *Yucca schidigera* and *Quillaja saponaria* on growth performance and enzymes activities of juvenile shrimp *Litopenaeus vannamei*

Quillaja saponins—a natural growth promoter for fish

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Abstract

Environmental concerns and the forthcoming ban on antibiotics in the European Union have renewed interest in renewable and non-persistent plant-based growth promoters in fish feeds. A review of the published literature and unpublished recent results following addition of a *Quillaja* saponin mixture in the diets of common carp and Nile tilapia are presented. It emerges that *Quillaja* saponins have the potential to increase growth in culture fish species, reduce their metabolic rate and suppress reproduction in tilapia. The current study is the first to have demonstrated beneficial effects of a *Quillaja* saponin-rich fraction when used as a feed additive in fish diet. It is hoped that this collation of information and synthesis of results, discussion and conclusions will act as a catalyst for future research on isolation of the active fraction, its optimum concentration for obtaining the desired effects, and physiological mechanisms of action for the diverse biological effects of these compounds.

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Keywords: Saponins; Fish; Carp; Tilapia; Performance; Reproduction

quality, growth performance, immune-oxidative status, digestive intestine histomorphology.

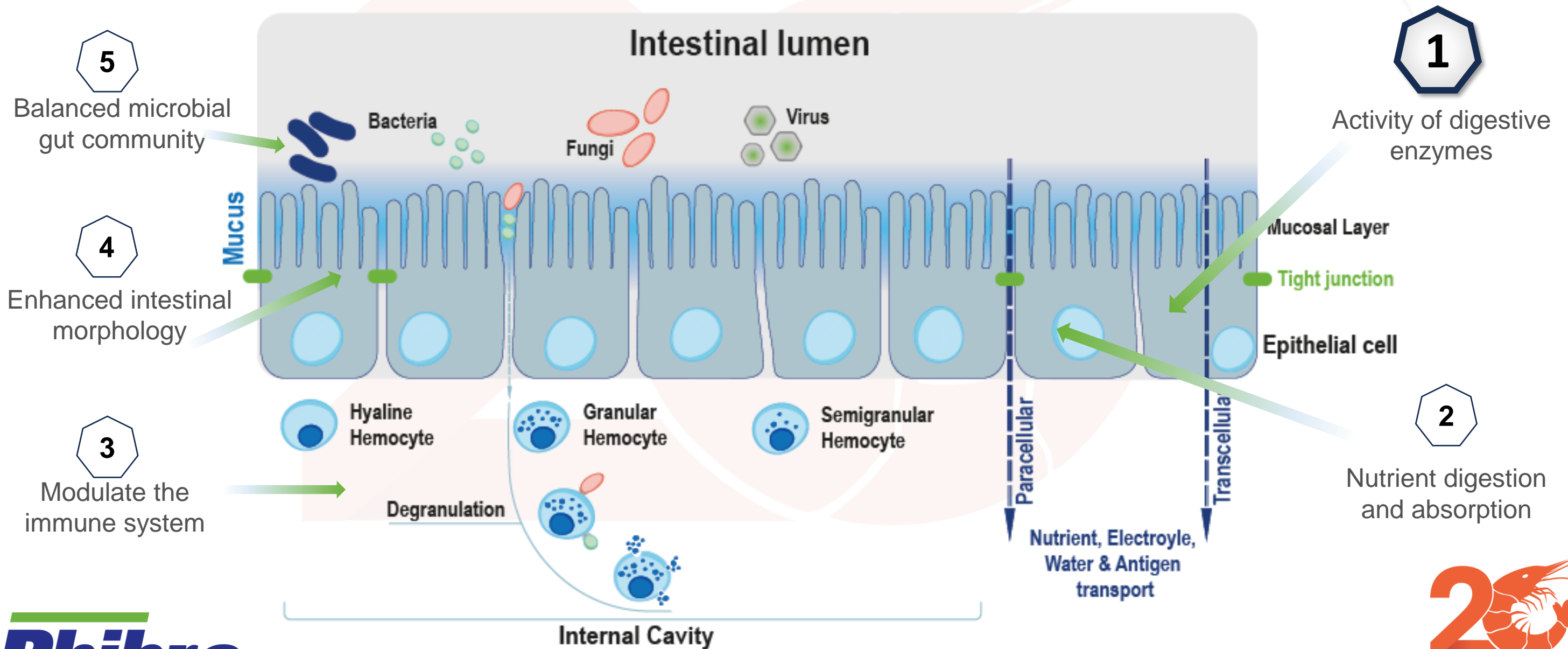
KEYWORDS

ammonia, blood health, feed efficiency, gills and intestinal histomorphology, *Oreochromis niloticus*, *Quillaja saponaria*, *Yucca schidigera*

0.25 g kg⁻¹ of NTF treatment. However, any significant differences in enzyme activities were detected between the control group and treatments. The increase effect in shrimp growth and any decrease effect in enzyme activity detected in present study suggest that NTF shows potential as a feed additive for shrimp cultured at low-salinity.

Keywords: *Litopenaeus vannamei*, growth, enzyme activity, low-salinity, aquaculture.

How can we improve gut health and functionality?

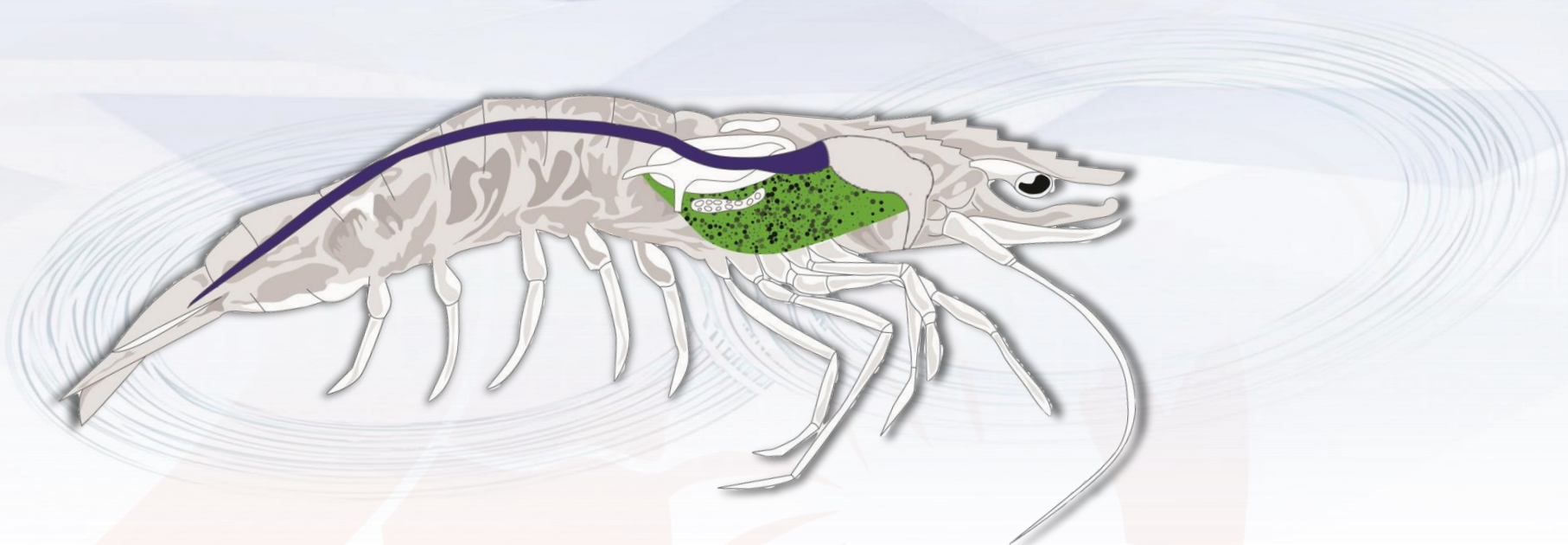


Evaluation of saponin-based supplement (SBS) on the enzymatic activity of Pacific white shrimp, *Litopenaeus vannamei*

Production of digestive enzymes

Species	Shrimp
Treatment	Control vs SBS
Number Replicas	4
Duration	28 days
Stocking	30 Shrimps/tank
Initial Weight	2g
Inclusion of SBS	2kg/MT

Enhanced enzyme activity



Enzyme activity in the hepatopancreas

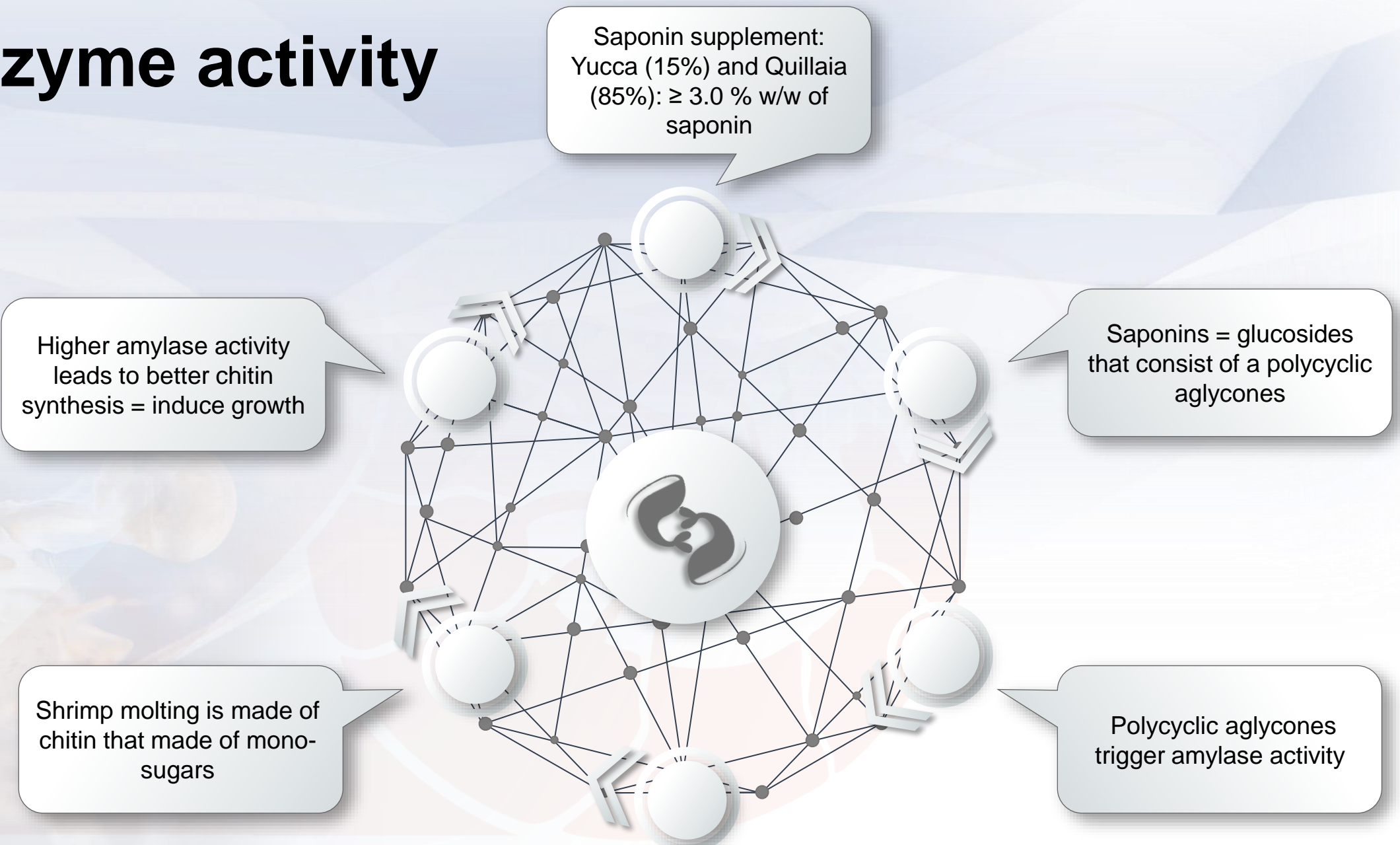
Enzyme (UI/g)	Control	SBS
Amylase	311.79 ±175	378.63 ±129*
Lipase	58 ± 28	57.03 ± 42

Enzyme activity in the gut

Enzyme (IU/g)	Control	SBS
Amylase	1242±384	1811±312*
Lipase	104±25	123±50*

Enhanced enzyme activity

Amylase activity



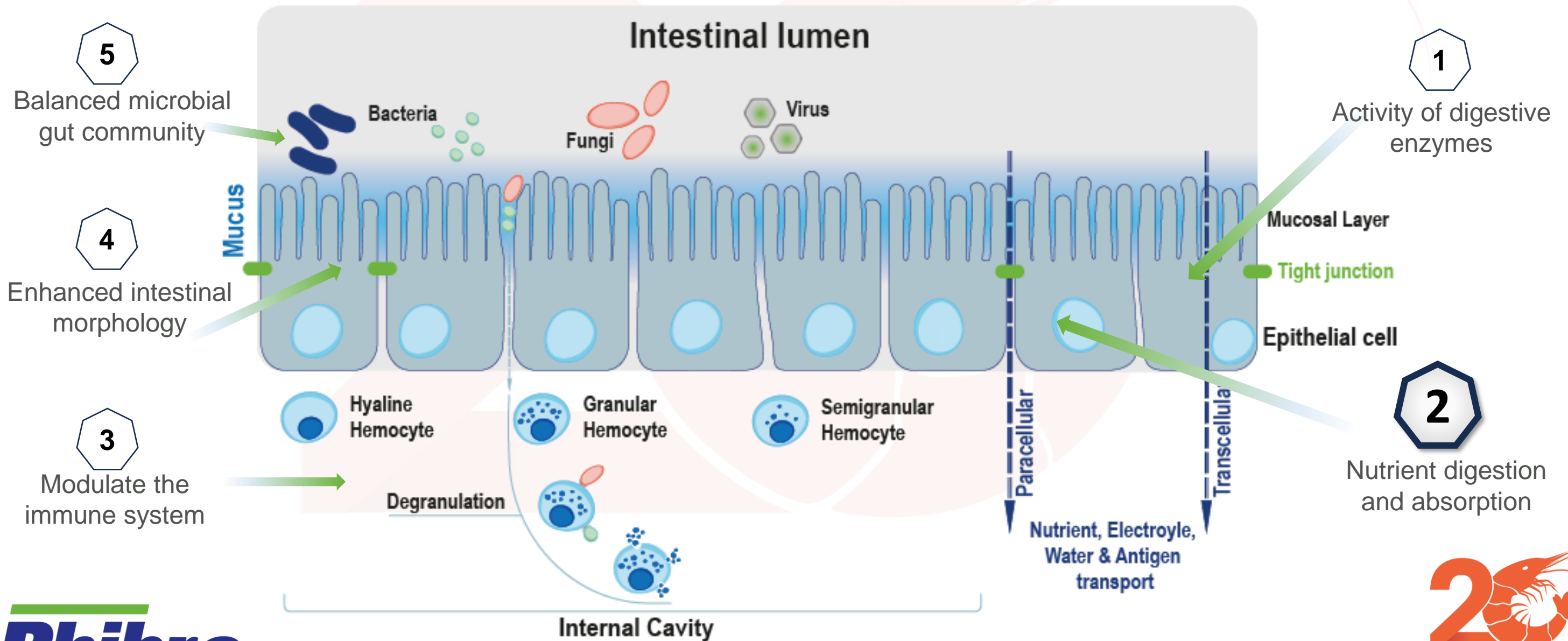
Lipase activity

Lipid requirement in shrimp is limited to 5-8%.

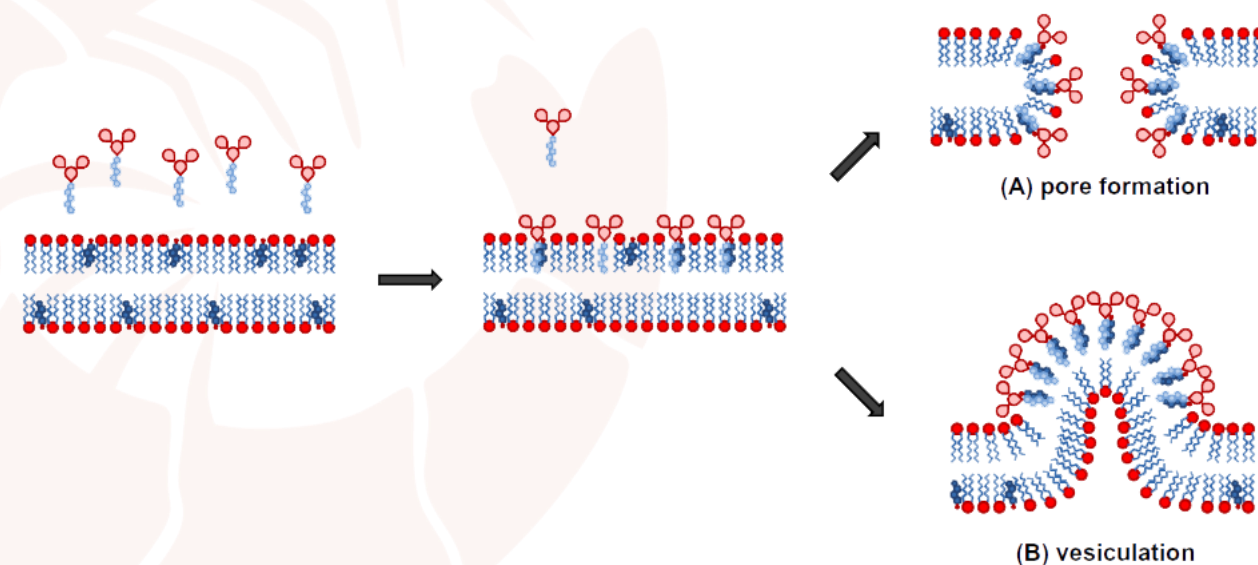
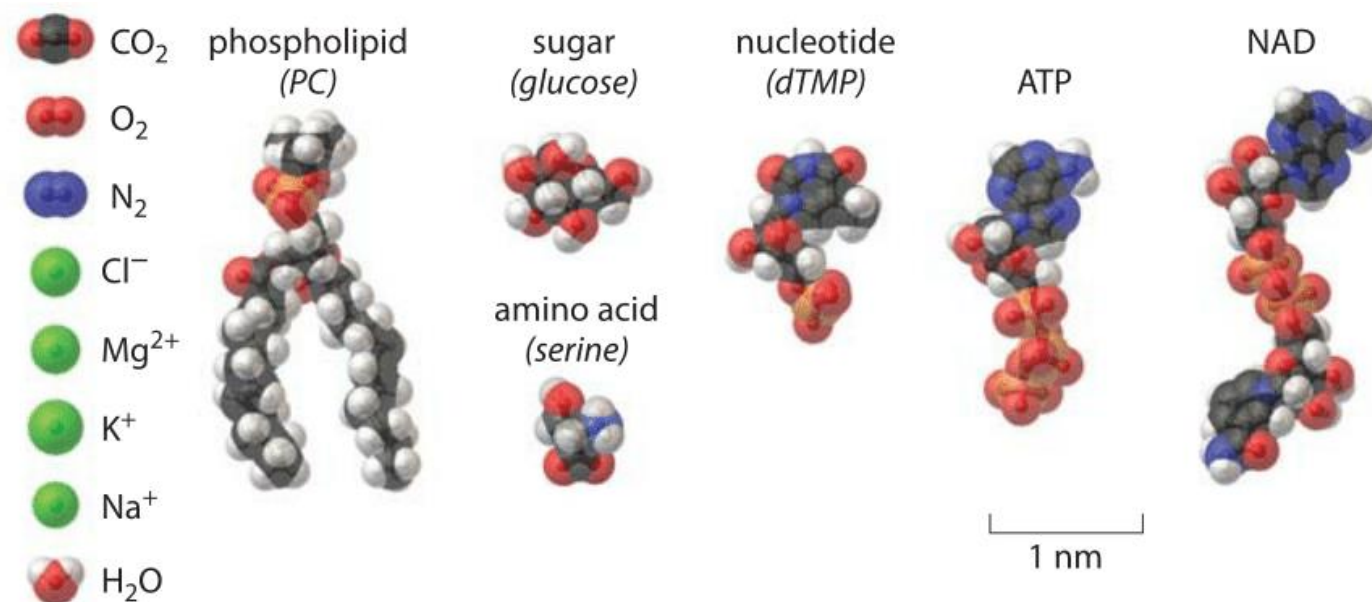
Enhanced lipase activity enable better extraction of fatty acids.

Inducing lipase activity can lead to optimum growth by improving digestibility of fatty acids within the lipid constraint.

How can we improve gut health and functionality?




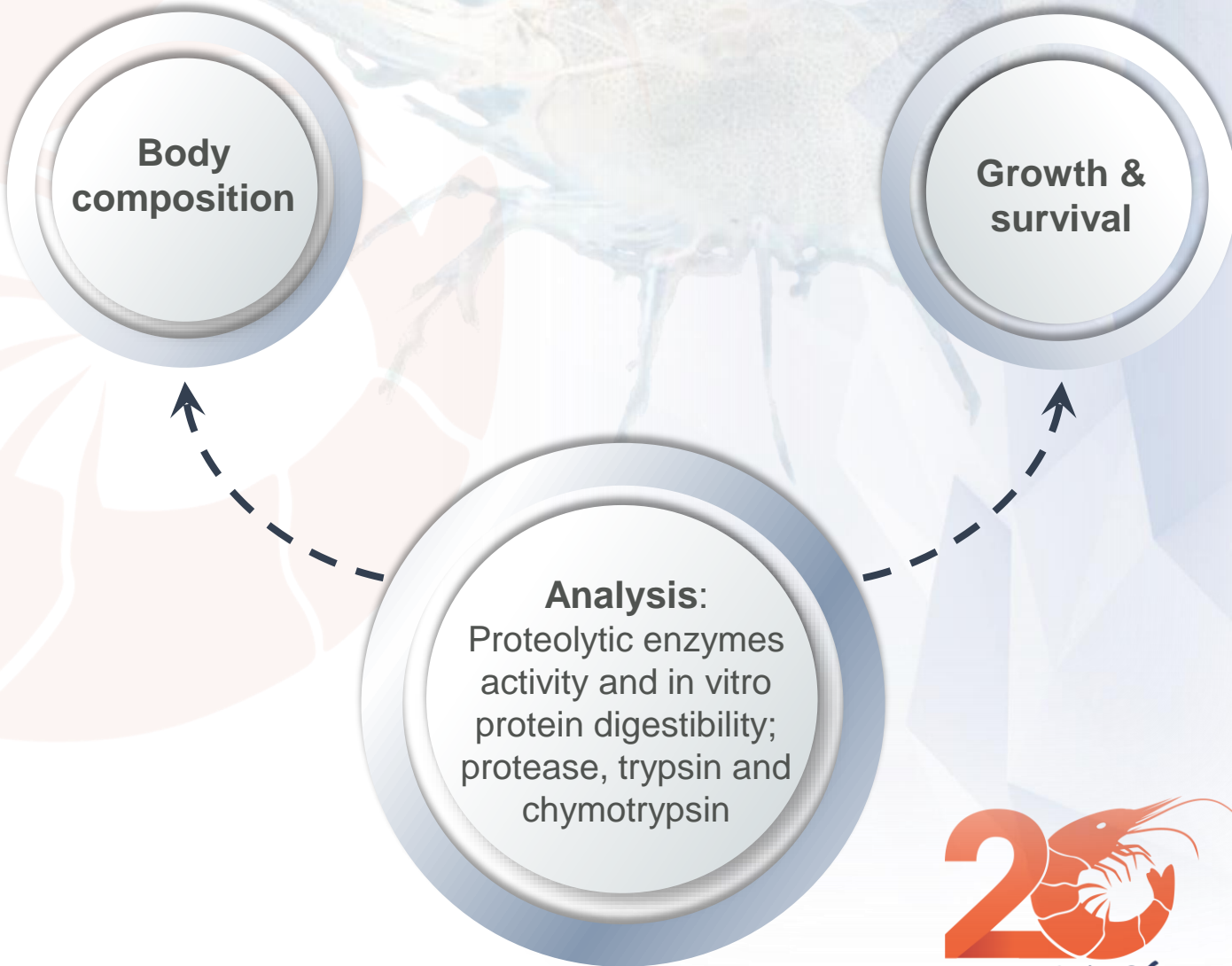
The ability of Saponins to form pores and membrane elasticity



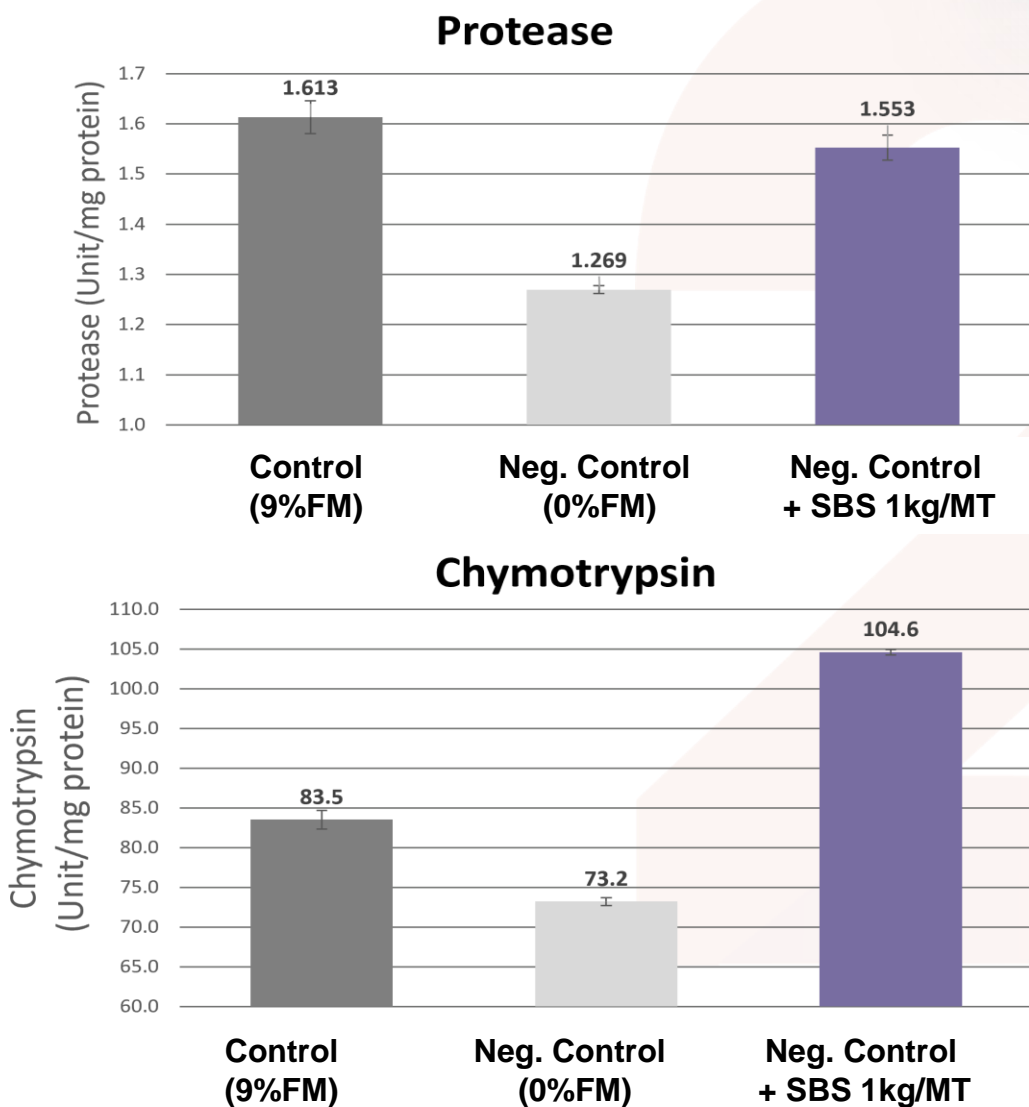
Effect of SBS on digestibility of soybean-meal-based diet in *L. vannamei*

Improvement in digestion and absorption

	Species	Shrimp
	Treatment	Control vs SBS <ul style="list-style-type: none">Control (9% fishmeal inclusion) without SBSNegative control (0% fishmeal inclusion Soybean based meal) without SBSNegative control with SBS 1kg/MT
	Number Replicas	4
	Duration	60 days
	Stocking	100 Shrimps/tank
	Initial Weight	0.51± 0.10g



Effect of SBS on digestibility of high soybean meal diet with *L.vannamei*




	Control (9%FM)	Neg. control (0%FM)	Neg. control + SBS 1kg/MT
Protein	75.8±1.1	75.0±0.7	75.3±2.1
Arginine	7.74	7.93	8.95
Histidine	0.71	0.73	0.74
Isolucine	1.2	1.3	1.59
Leucine	1.99	1.93	2.44
Lysine	3.69	3.76	4.44
Methionine	0.79	0.81	0.85
Phenylalanine	1.37	1.34	1.17
Threonine	1.21	1.36	1.07
Tryptophan	0.53	0.39	0.42
Valine	1.21	0.35	1.32
Sum EAA	20.4	19.9	22.9

*EAA (Essential Amino Acids)

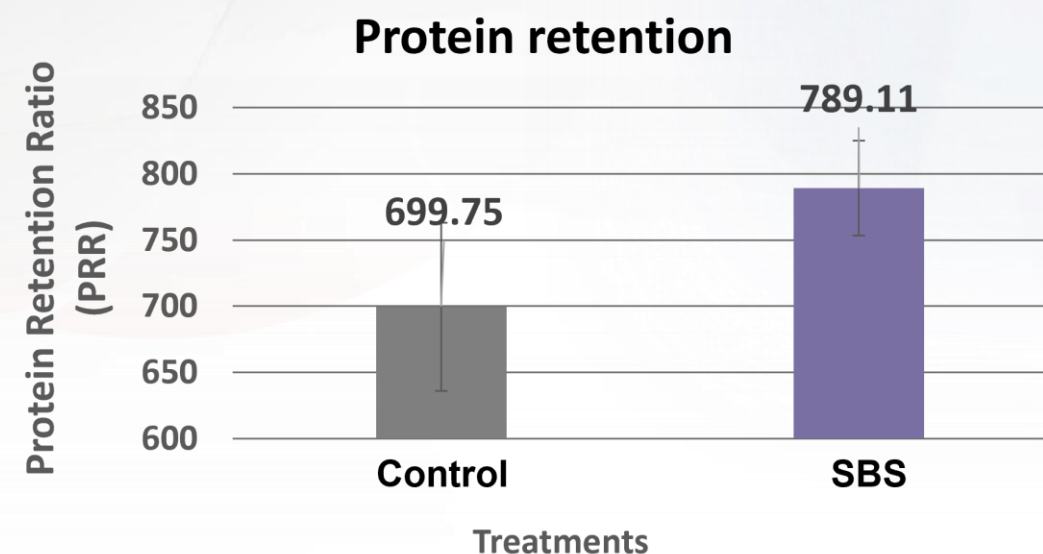
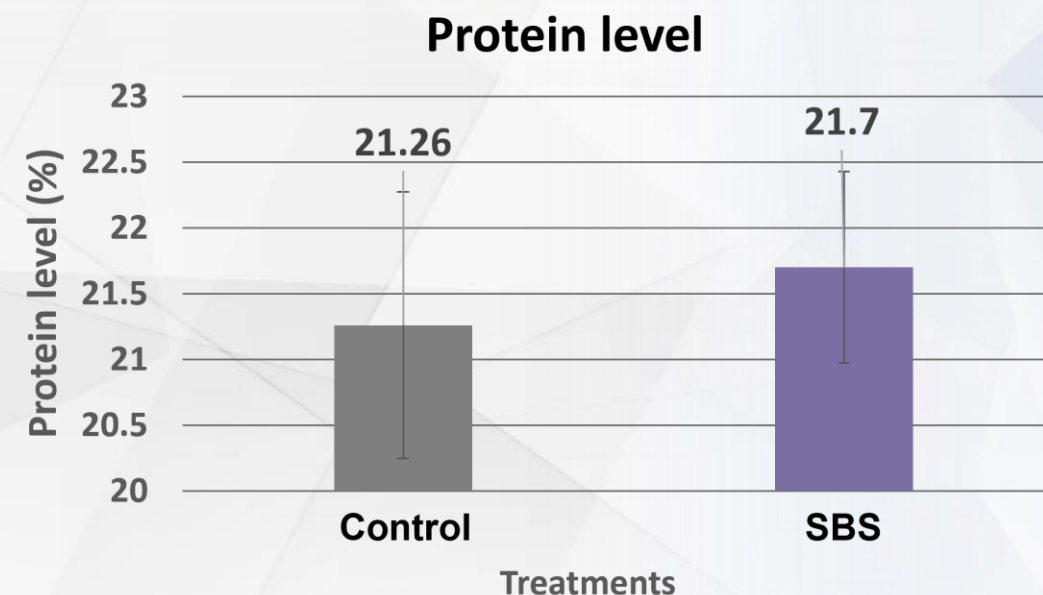
SBS Metabolic analyses of shrimp – protein level and retention

Batam Dae Hae Seng research station, Indonesia

	Species	Shrimp
	Treatment	Control vs SBS
	Number Replicas	6
	Duration	60 days
	Stocking	180 Shrimps/tank
	Initial Weight	Size- 4.24±0,03 g initial weight with <i>L. vannamei</i>
	Inclusion of SBS	2kg/MT

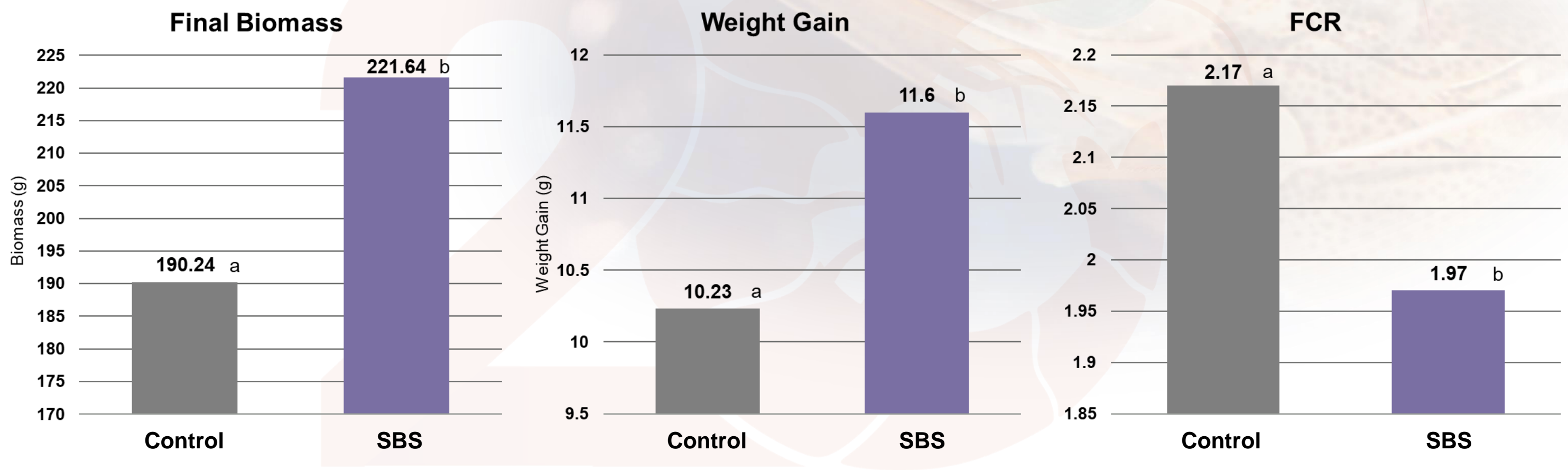
- Analysis:**

- Protein level %: Kjeldahl method
- Protein retention ratio (PRR)

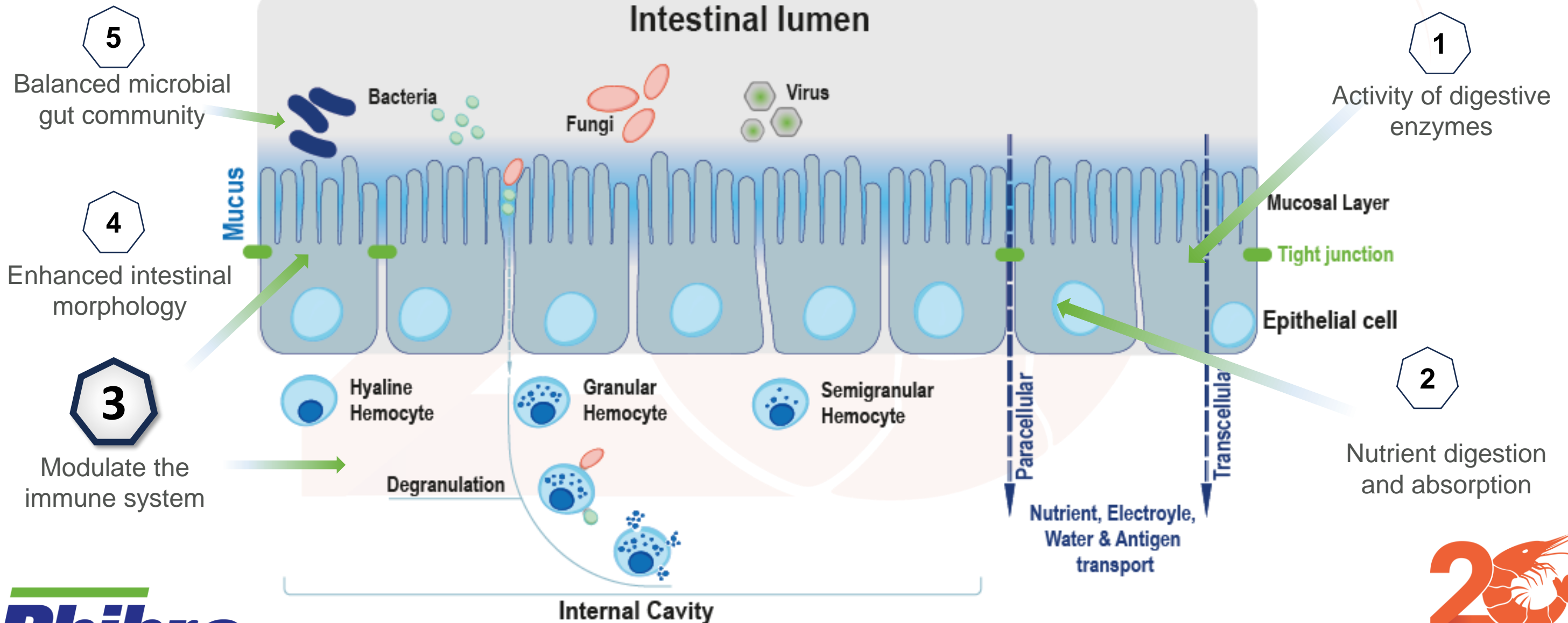


Results

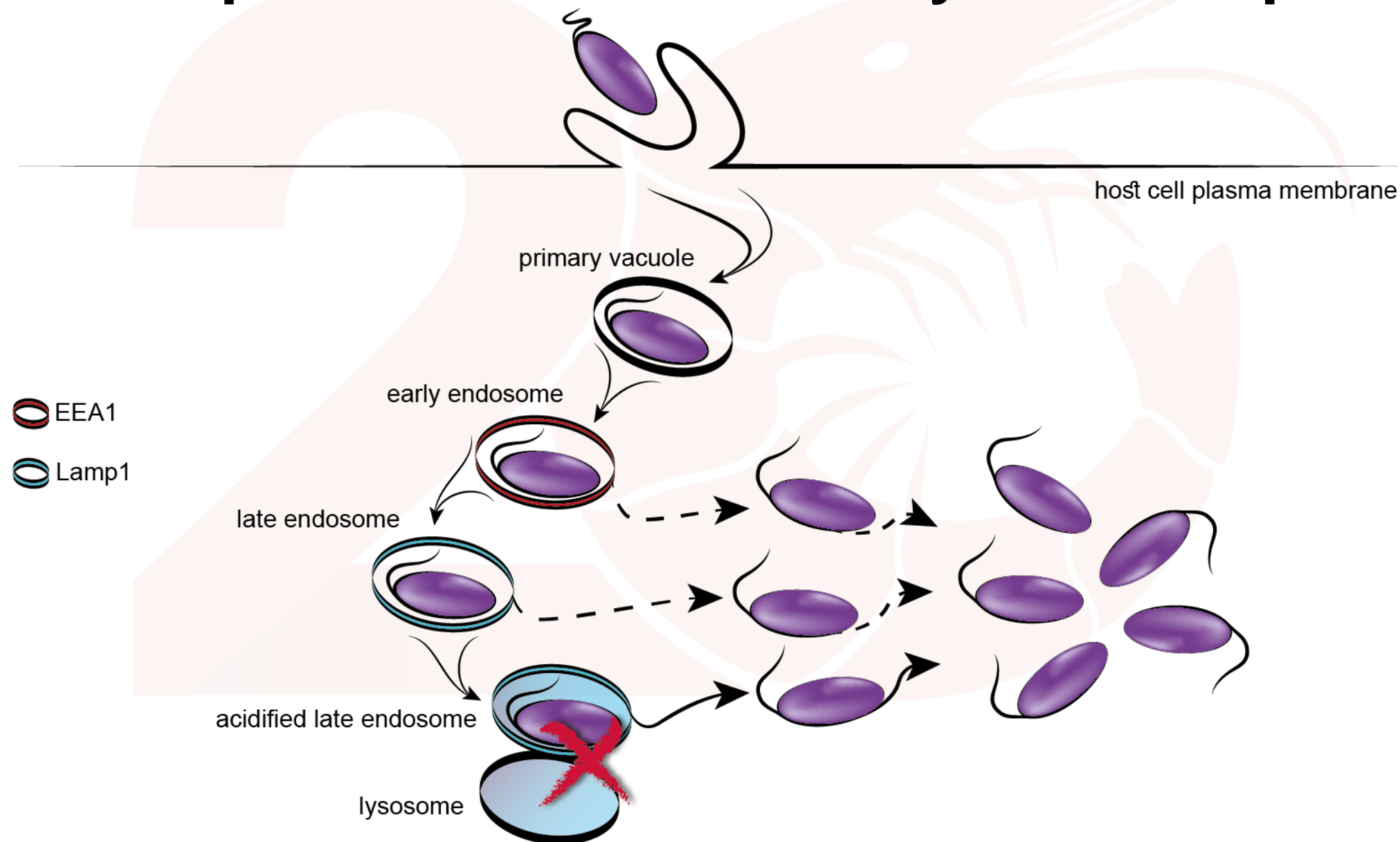
Performance



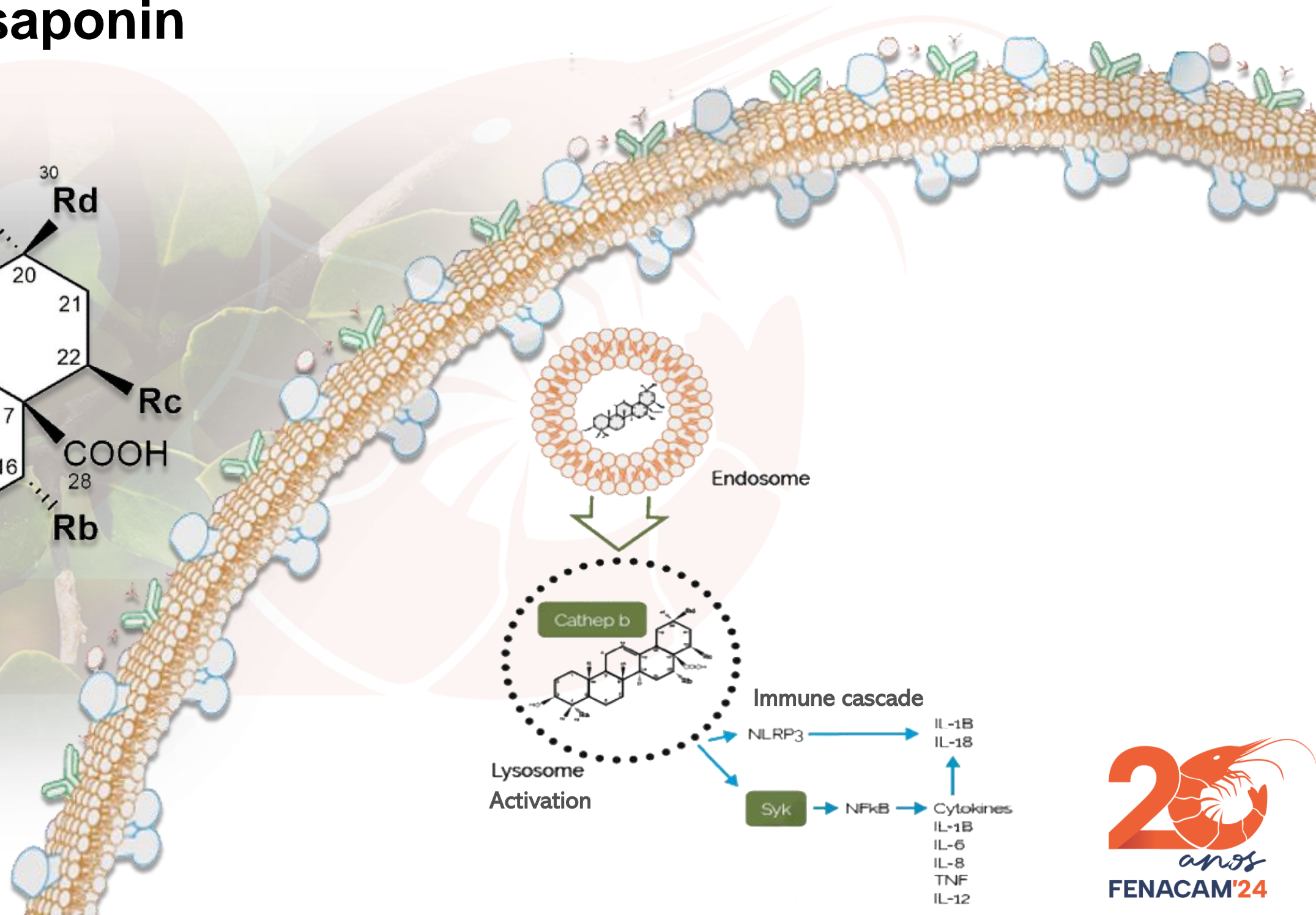
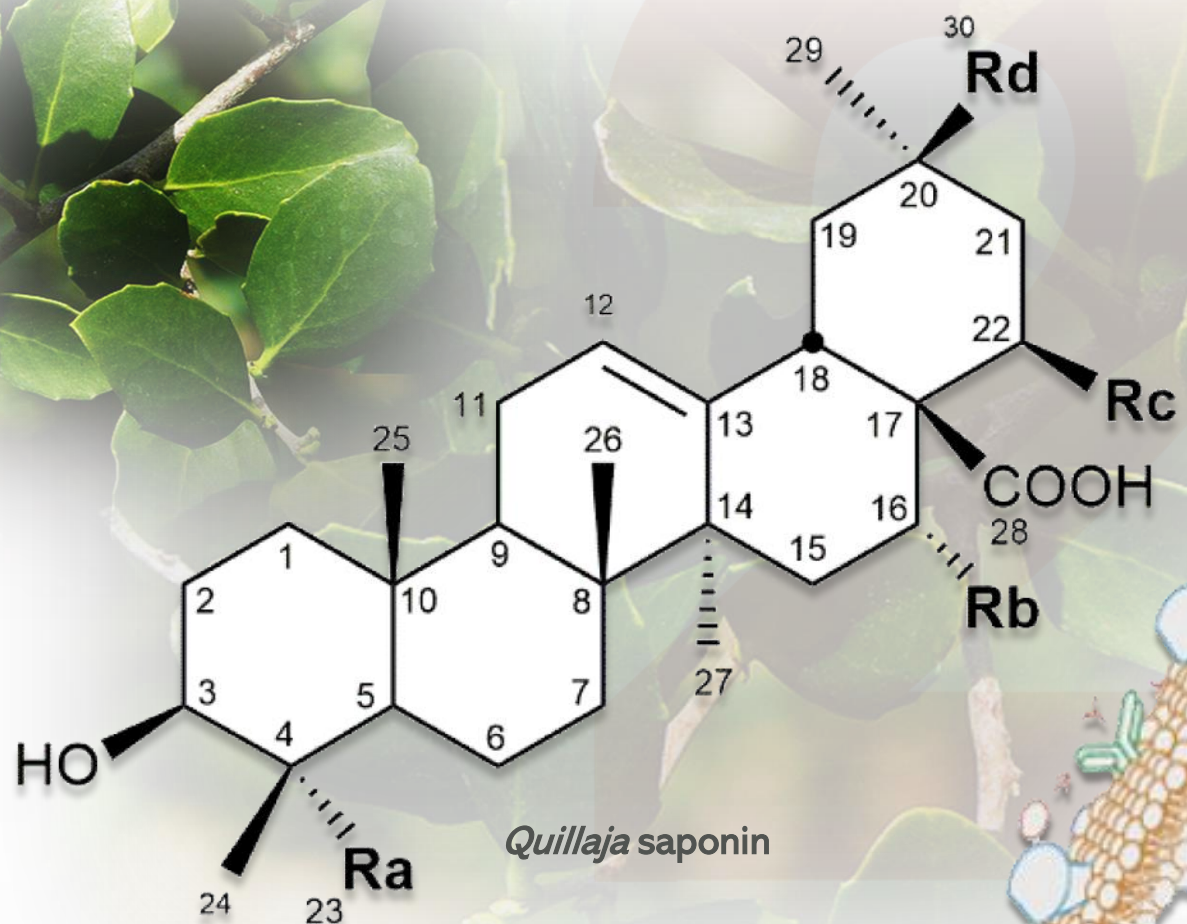
How can we improve gut health and functionality?



Intracellular *Vibrio parahaemolyticus* escapes the vacuole and establishes a replicative niche in the cytosol of epithelial cells



Proposed mechanism of enhancement of immune response in shrimp by *Quillaja* saponin



Evaluating the effect of SBS on growth performance and overall health status of *Litopenaeus vannamei* culture under normal and challenge conditions

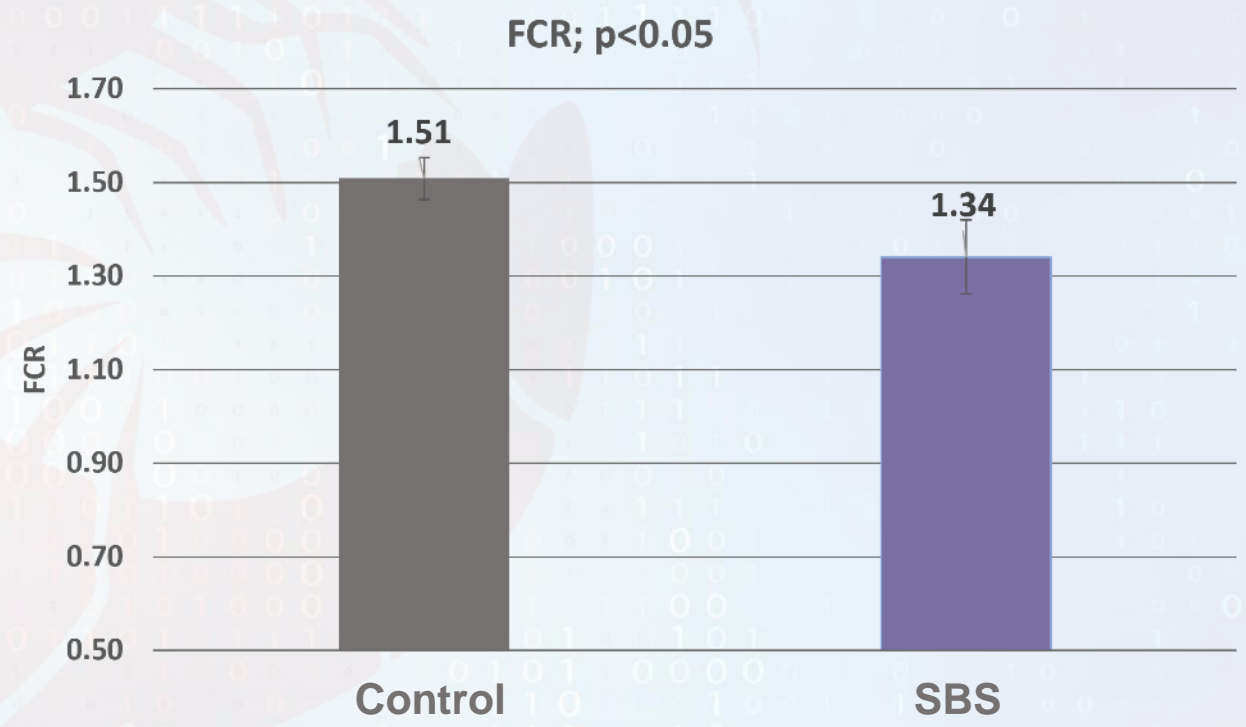
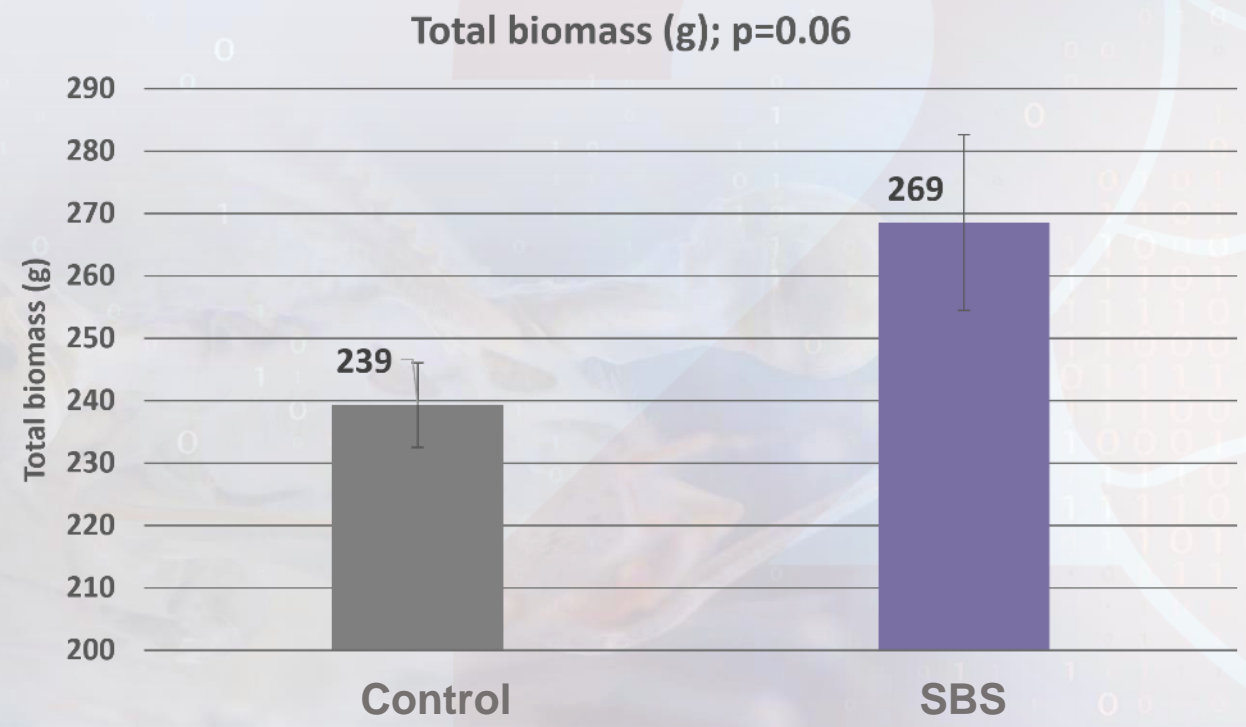
Kasetsart University, Thailand - 2021

Species	Shrimp <i>L. vannamei</i>
Treatment	Control vs SBS 3 Kg/MT feed
Number Replicas	6
Duration	8 weeks
Stocking	25 Shrimps/tank
Initial Weight	Size 2±0.05g
Challenge	<i>Vibrio parahaemolyticus</i>

- Analysis:
- Growth performance
 - Blood and biochemistry
 - Bacteria count

Evaluating the effect of SBS on growth performance and overall health status of *Litopenaeus vannamei* culture under challenge conditions

Growth performance normal conditions



Survival was higher with SBS

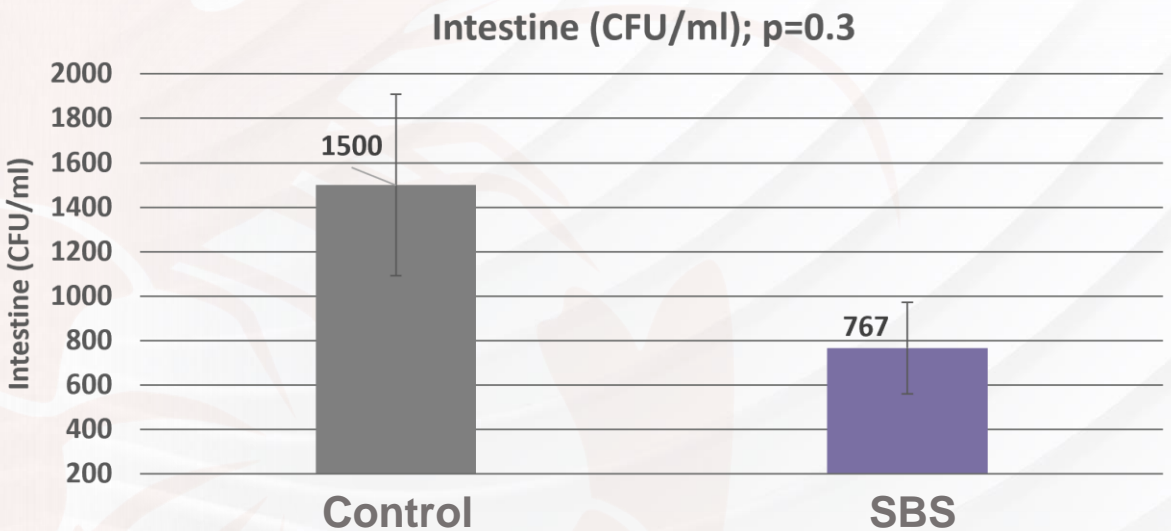
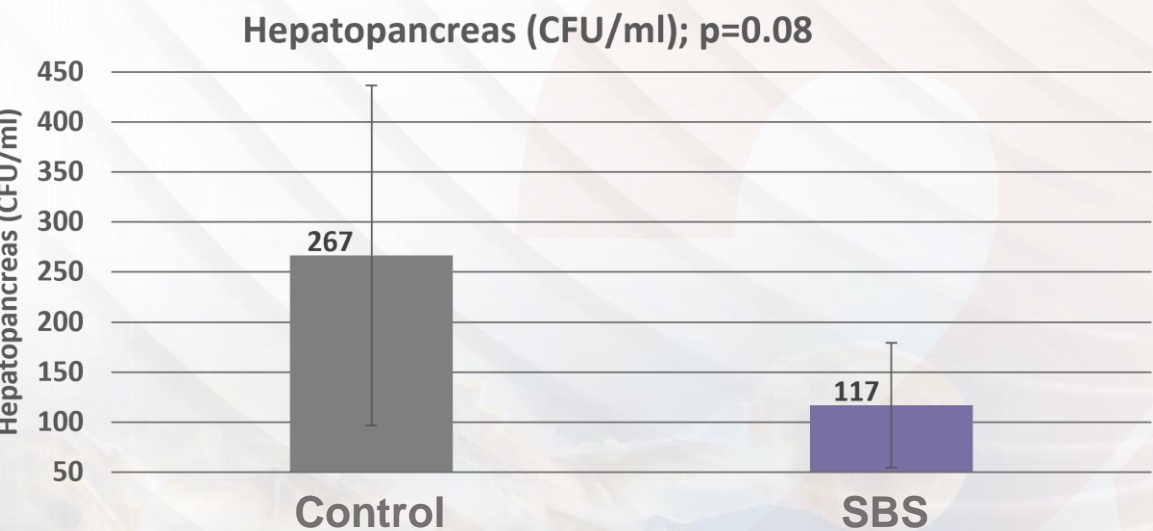
Evaluating the effect of SBS on growth performance and overall health status of *Litopenaeus vannamei* culture under challenge conditions

Immune parameters under challenge, one week after challenge

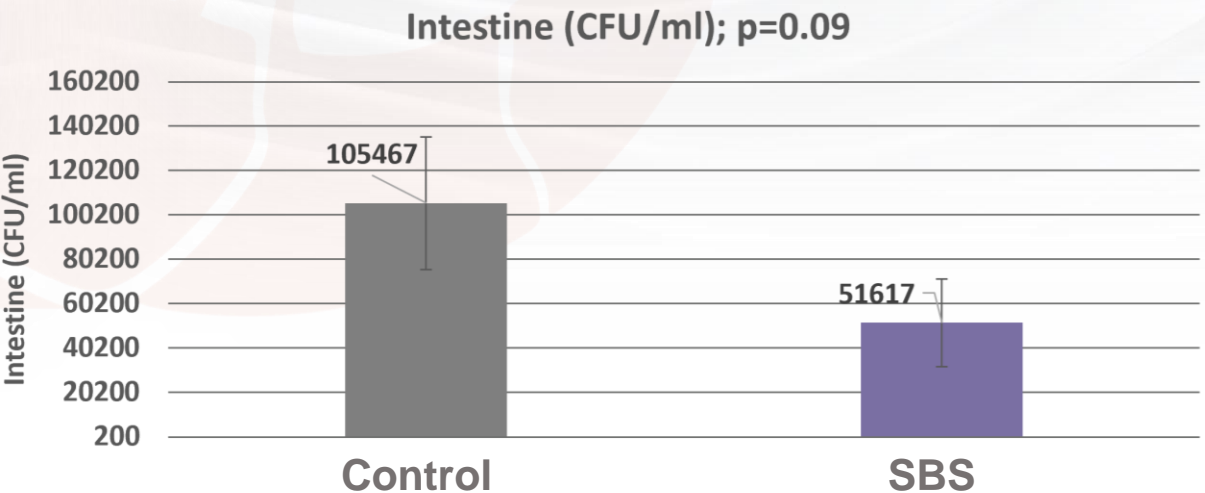
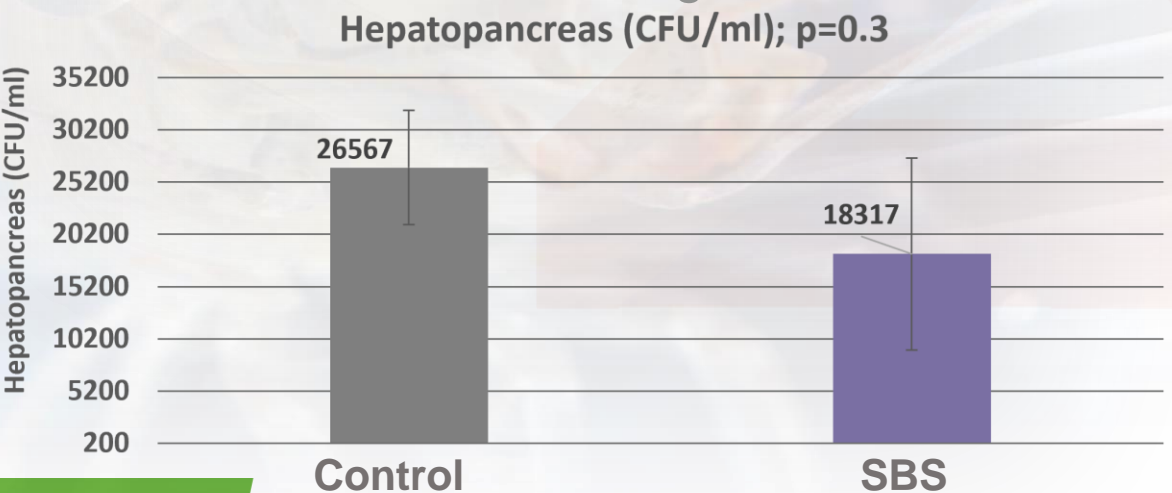
	Hemocyte count (x10 ⁵ cell/ml)	Hemolymph Protein (g/dL)	Phenoloxidase activity(unit/min/mg Protein)	Lysosyme	Superoxide dismutase (SODN)	Glutathionine
Control	29.7	1.0	250.6	30.0	7.4	30.3
SBS	32.7	2.1	284.3	43.3	11.1	32.4
P value	0.02	0.31	0.21	0.001	0.04	0.01

Evaluating the effect of SBS on growth performance and overall health status of *Litopenaeus vannamei* culture under normal and challenge conditions

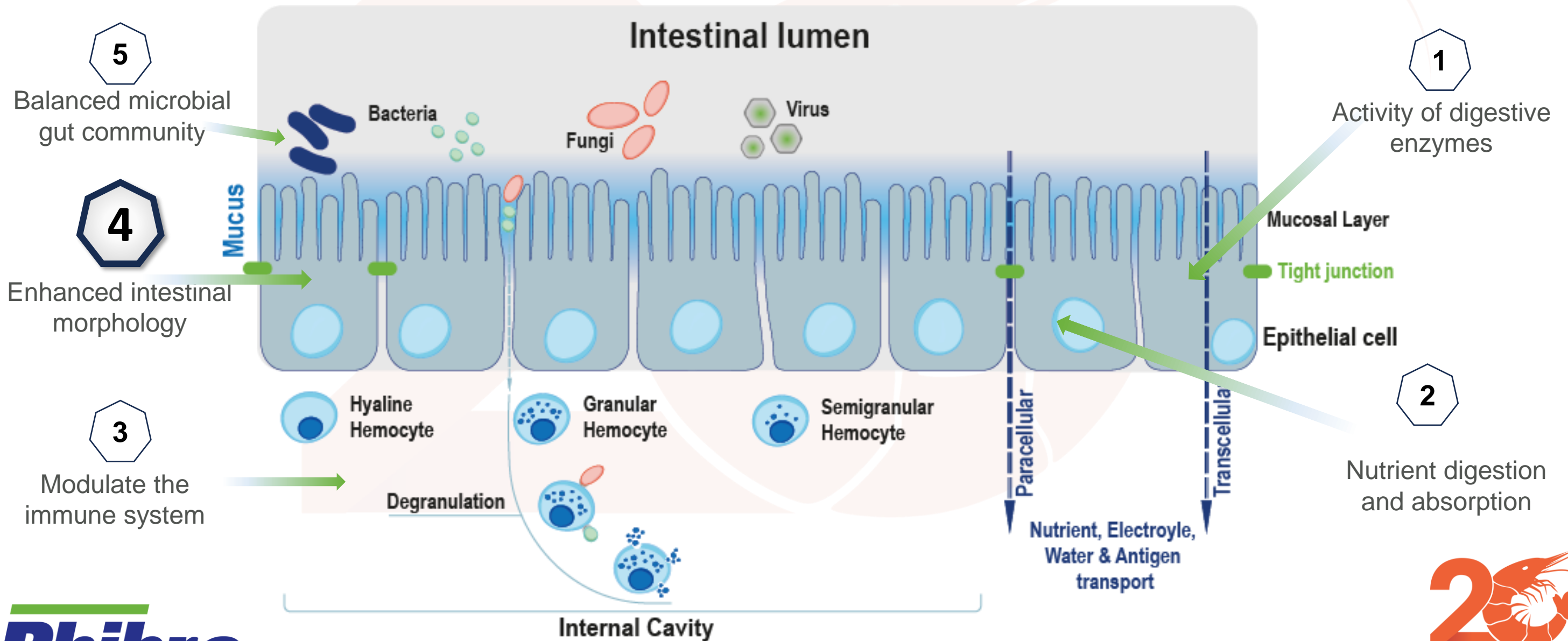
Bacteria count under normal condition



Bacteria count after challenge



How can we improve gut health and functionality?

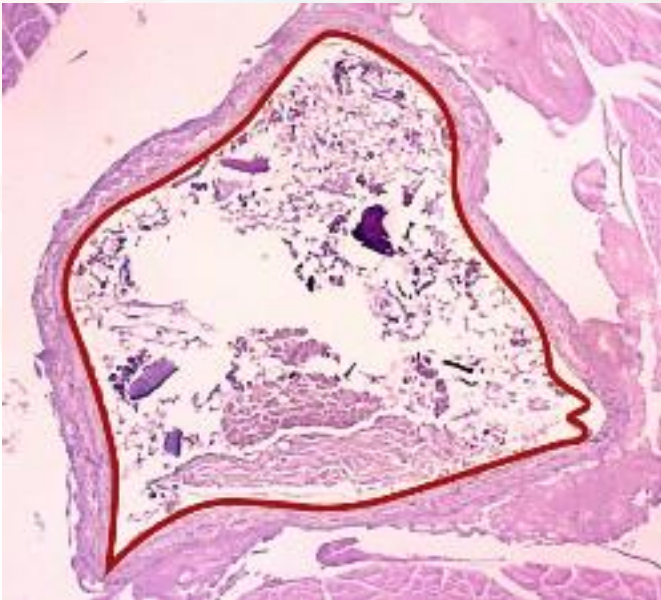


Inclusion effect of SBS in plant-based diet on histomorphology conditions of white-leg shrimp, *Litopenaeus vannamei*

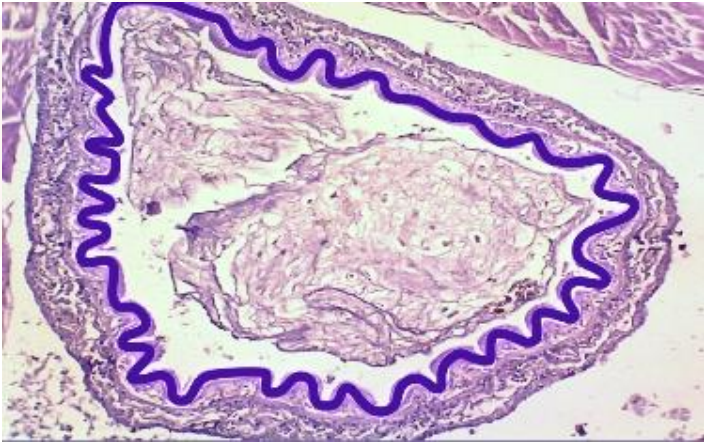


Treatment	<ul style="list-style-type: none"> - Commercial feed - Commercial feed + 2kg/MT of SBS
Animals	<i>Litopenaeus vannamei</i> , 2g (initial weight) 15 shrimp/aquarium
Duration	90 days
Facility	24 aquariums tanks: 75 x 40 x 40 cm (100 L each)
Temp	26 °c
Replicates	8
Location	Center for marine and fisheries, Jakarta Technical University of Fisheries located in Serang, Banten, Indonesia.

Growth performance was significantly better at the SBS treatment

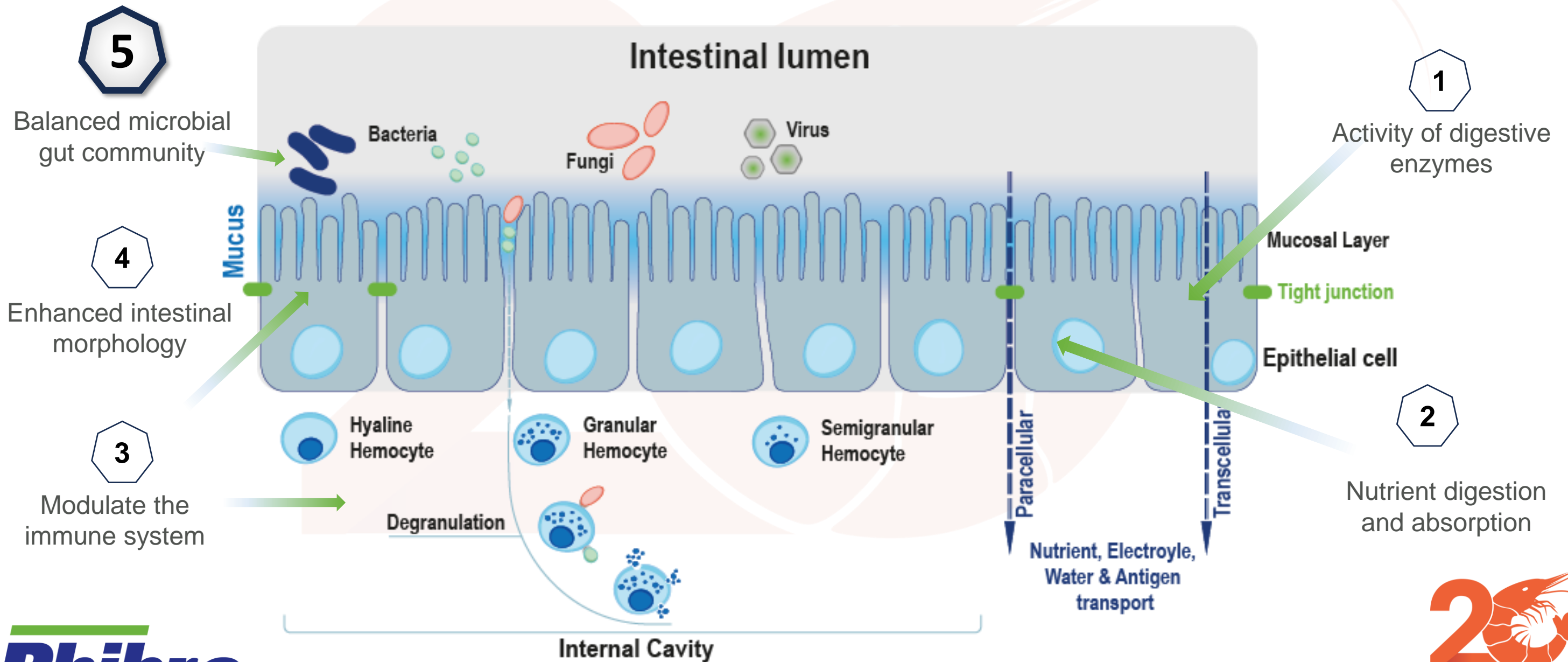


1. Commercial feed
Grade 0 – Low level to no intestinal folds



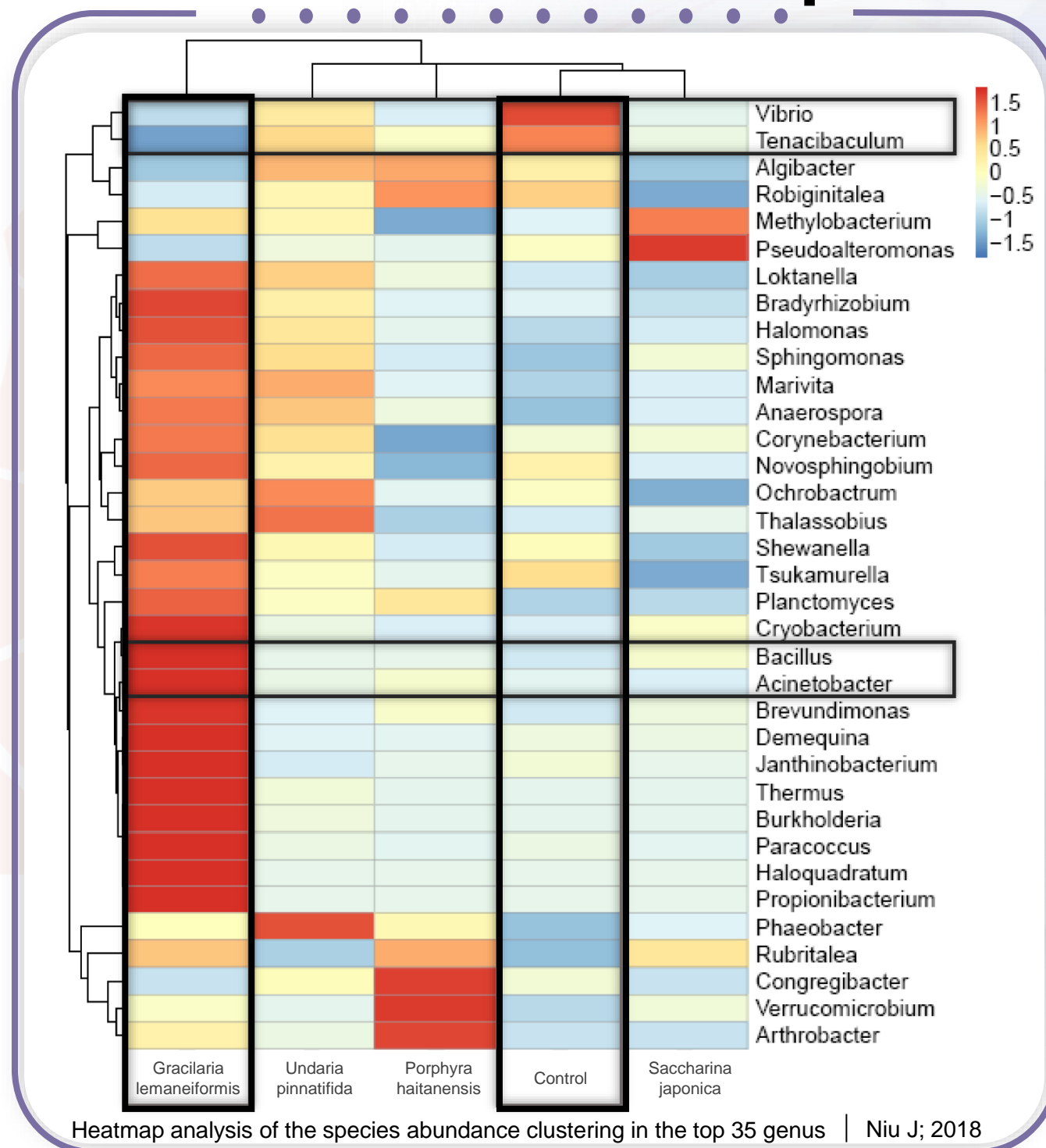
2. Commercial feed + 2kg/MT of SBS
Grade 4 – High level of intestinal folds

How can we improve gut health and functionality?

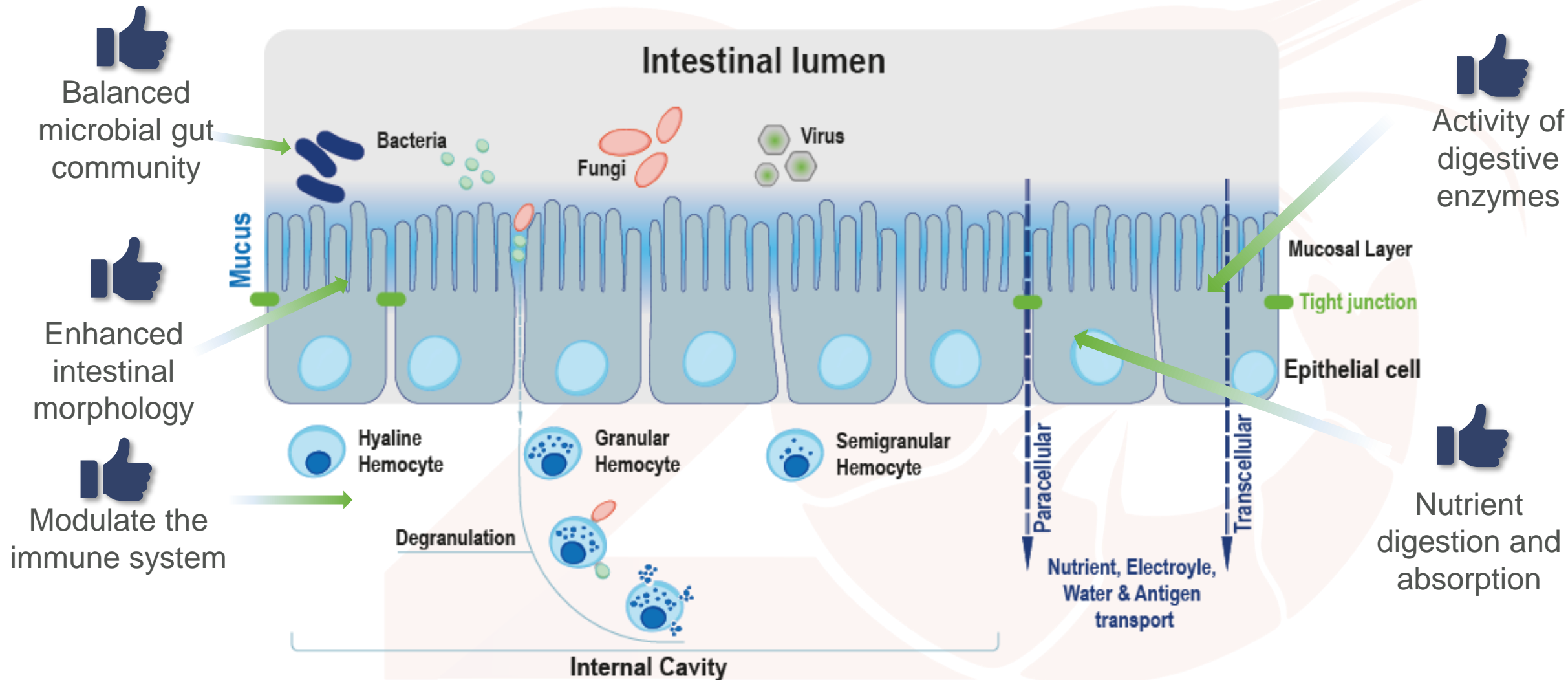


The Effect of Phytogenic on Microbiome in Shrimp Gut

- Intestinal microbiota supplies the host with nutritional and energy, acts as a pathogenic barrier, and exerts great influence on the maintenance of immune homeostasis
- *Gracilaria lemaneiformis* contains triterpenic saponins.
- *Gracilaria lemaneiformis* increased α -diversity of microbes in the intestine.
- We see significant impact on the microbial community vs control



How can we improve gut health and functionality?



PAQ-Protex®

(Quillaja saponaria e Yucca schidigera)
Aditivo Melhorador de Desempenho

Indicação do Produto:
Aditivo melhorador de desempenho para melhora da integridade intestinal e aumento do ganho de peso, eficiência alimentar e imunidade de peixes e camarões.

Composição Básica do Produto:
Quillaja (Quillaja saponaria) 85 % e Yucca schidigera 15 %.

Níveis de Garantia:
Quillaja saponaria (mín) 850 g/kg e Yucca schidigera (mín) 150 g/kg.

Dosagem e Modo de Usar:
Misturar a ração de forma contínua nas dosagens específicas na tabela abaixo, ou de acordo com a orientação do nutricionista.

Recomenda-se uma pré mistura do produto com milho moído fino ou premix, antes da mistura final.

Peixes	Camarão
250 - 500 g/ton	1.000 - 2.000 g/ton

Restrições de Uso, Contraindicações e Cuidados:
Assim como qualquer aditivo para ração, PAQ-Protex® deve ser mantido sob os cuidados comuns de segurança. Pode causar irritações nos olhos, pele, sistema respiratório ou reações alérgicas devido ao contato com o produto. Ao manipular o produto, usar equipamentos de proteção individual (roupas protetoras, óculos, luvas impermeáveis e máscara anti-pó). Os operadores devem tomar banho após a jornada de trabalho. Se acontecer contato acidental com os olhos e a pele, lavar com água abundante. Em caso de ingestão acidental procurar o médico imediatamente, levando consigo a embalagem do produto. Não há antídoto específico. Não contaminar lagoas, cursos de água ou canais com produto ou recipientes.

Condições de Armazenamento:
Conservar na embalagem original, em lugar fresco e seco, a temperatura ambiente. Evitar a luz solar. Manter fora do alcance de crianças.

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Responsável Técnico: Bruno Takashi Bueno Honda - CRMV-SP 28.942

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Data de fabricação: XX.XXX.XXXX
Data de validade: XX.XXX.XXXX



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