GUT HEALTH AND ITS IMPACT ON PRFORMANCE

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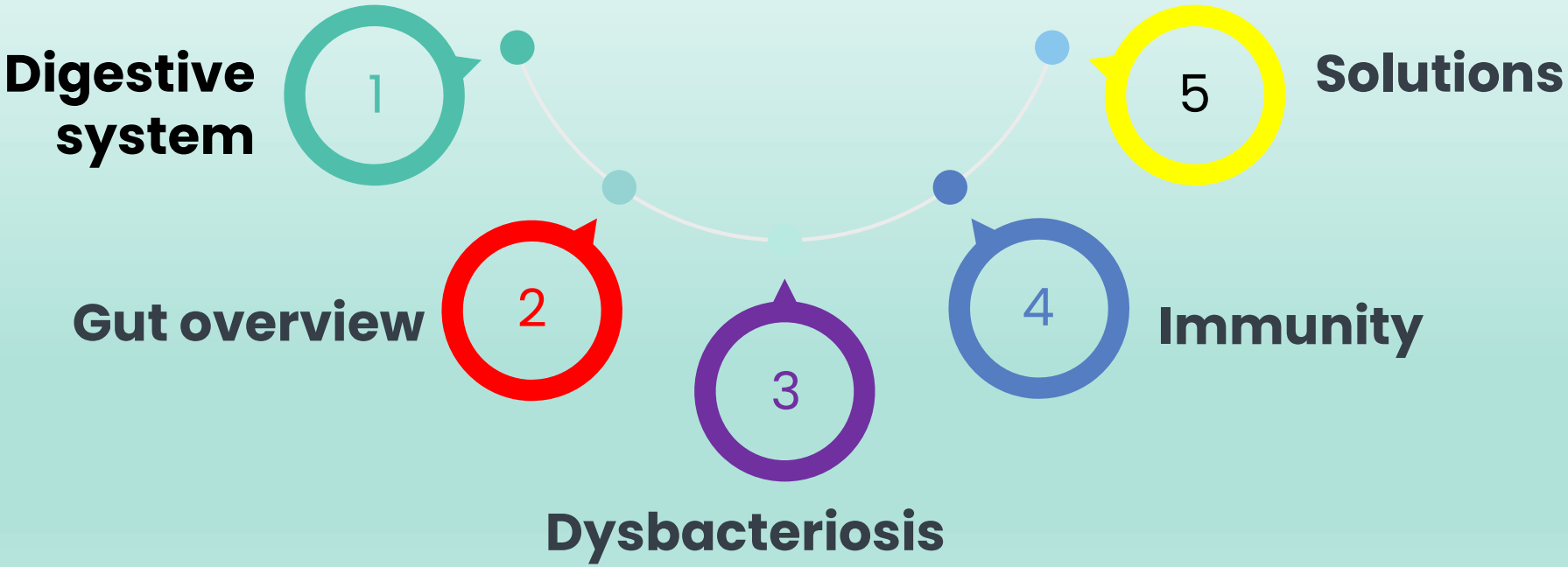
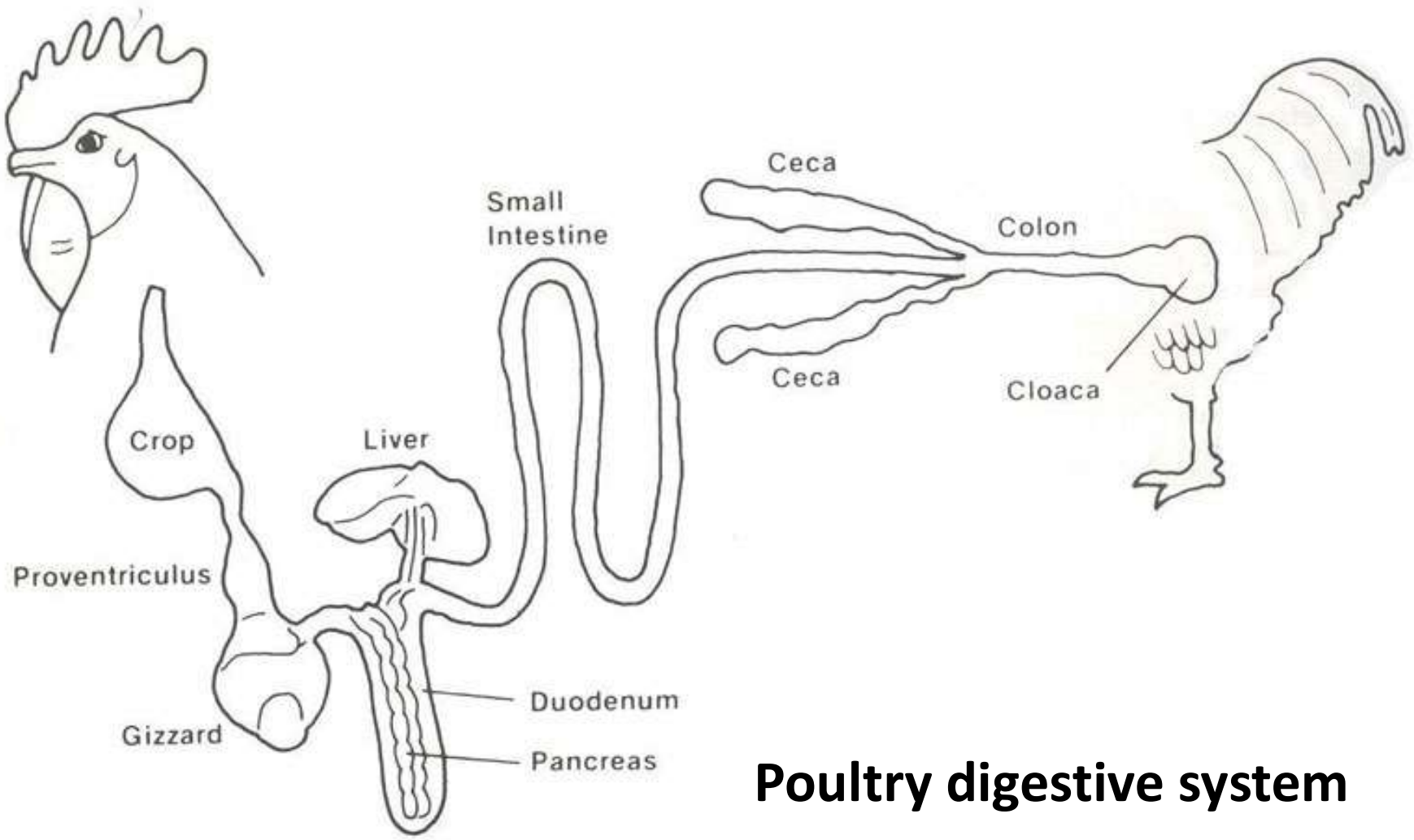
PRESENTATION OVEREW

- Poultry digestive system
- Gut overview
- Dysbacteriosis
- Immunity
- Solutions
- Recap

Presentation Overview

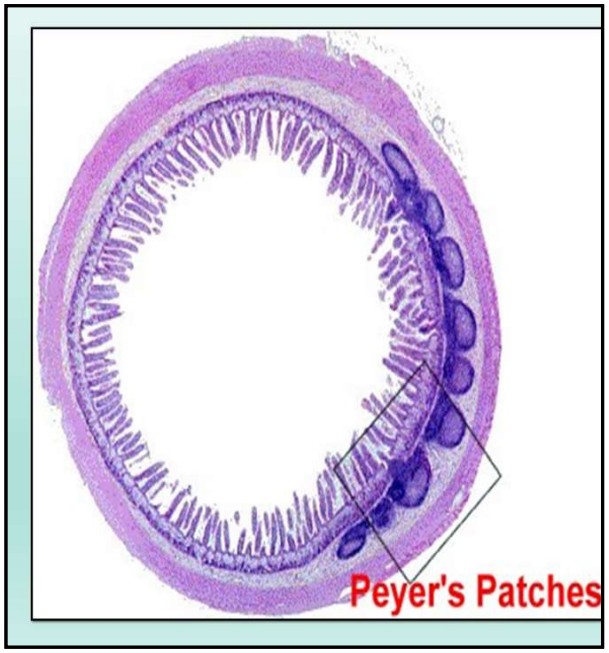




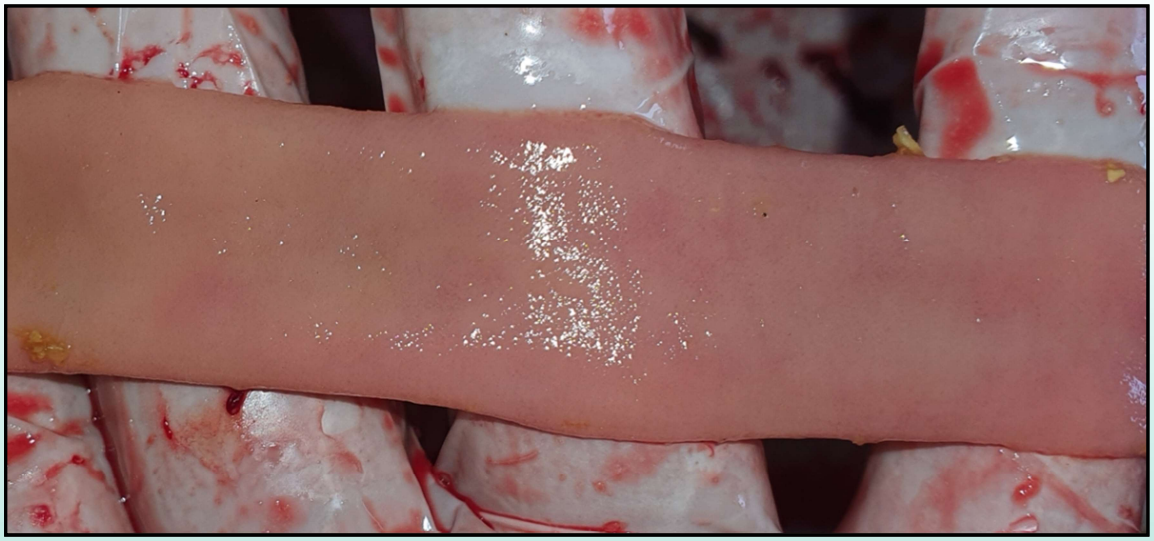
Poultry digestive system

GUT OVERVIEW

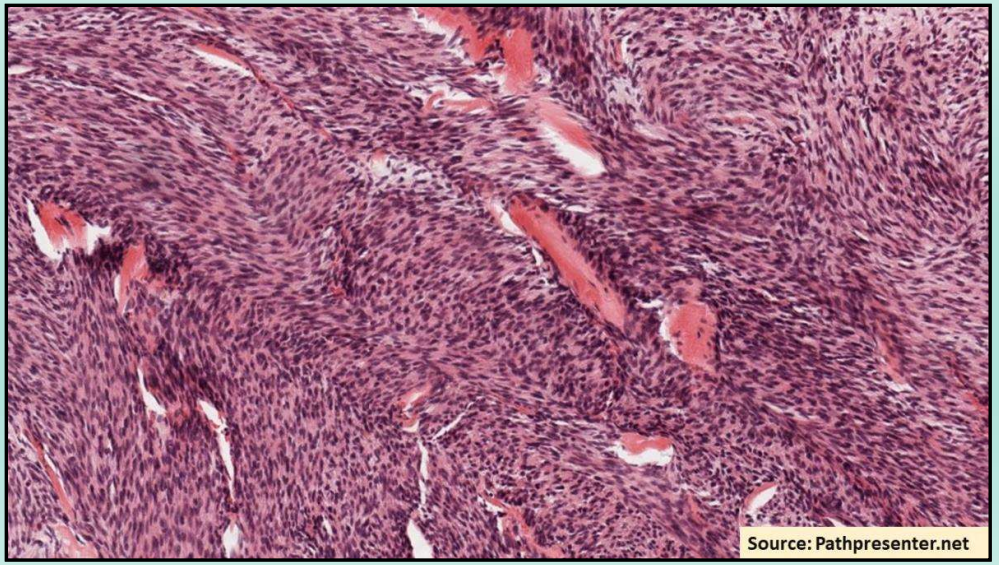
- Largest immune and neuroendocrine organ of the bird.
- It acts as physical, chemical, microbial and immunological barrier.
- Contains around 70 % of immune cells in body.
- Gut health is relied on balanced gut microflora, availability of feed/water and proper and early development of gut tissue.



Gut associated lymphoid tissue



Normal intestinal surface Herringbone pattern



PASTY VENTS IN BROILER CHICKS

PASTY VENTS IN ADULT BROILERS

Subclinical and clinical coccidiosis

Clinical and subclinical coccidiosis

Gut Ballooning

Thinning of gut wall

Lesions in intestine and ceca

Subclinical and clinical Bacterial Enteritis



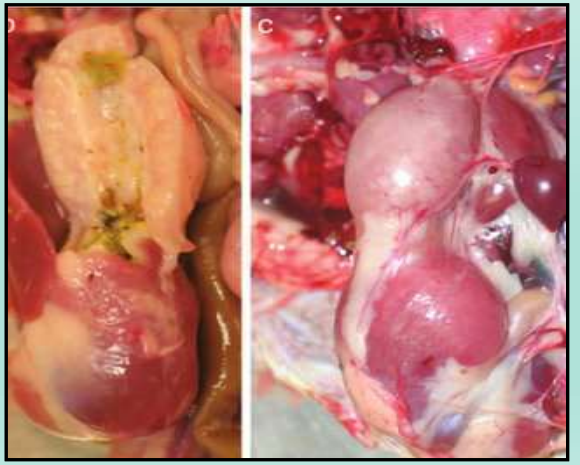


MALABSORPTION SYNDROME
(Viral arthritis)

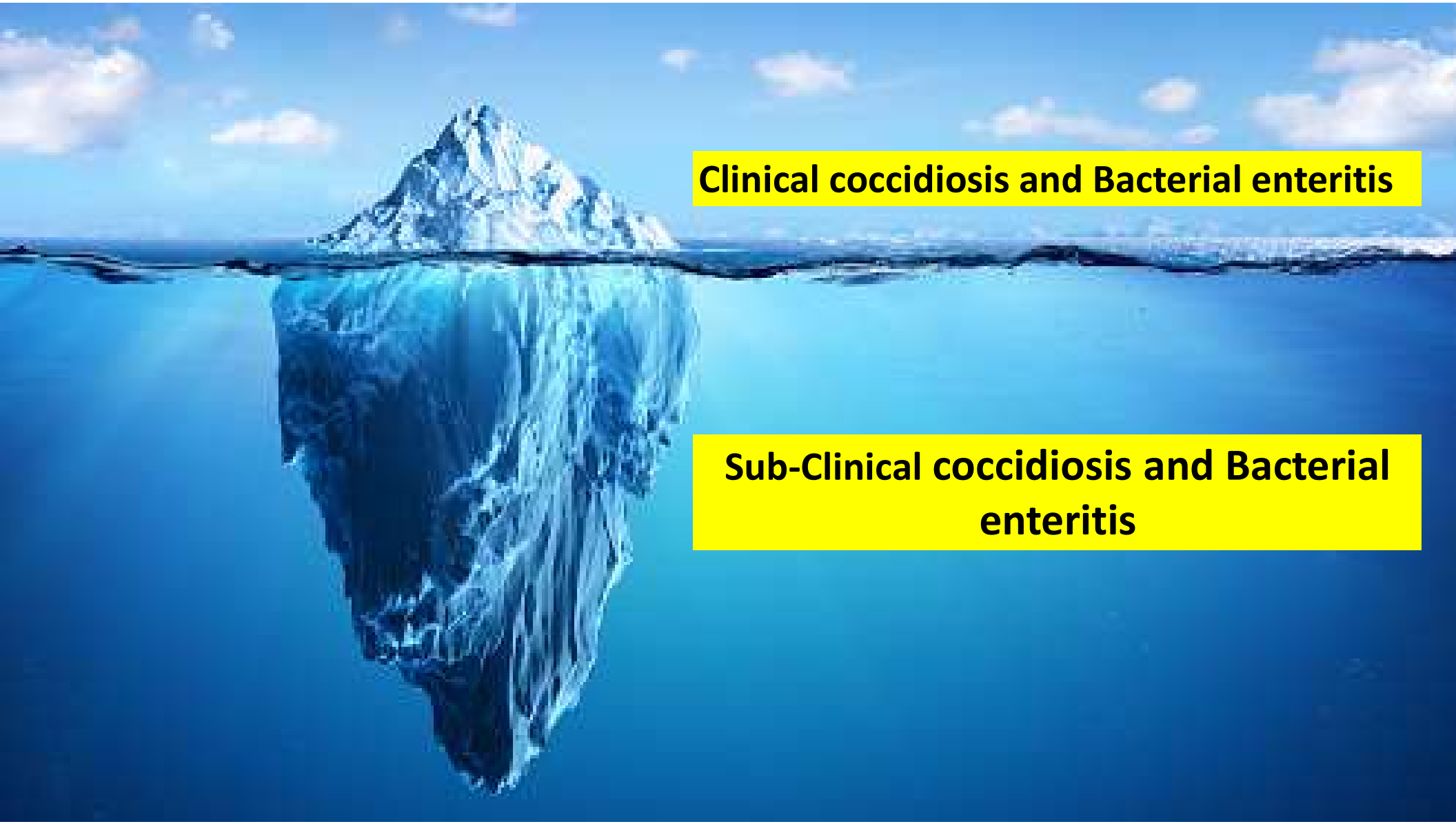
MAS

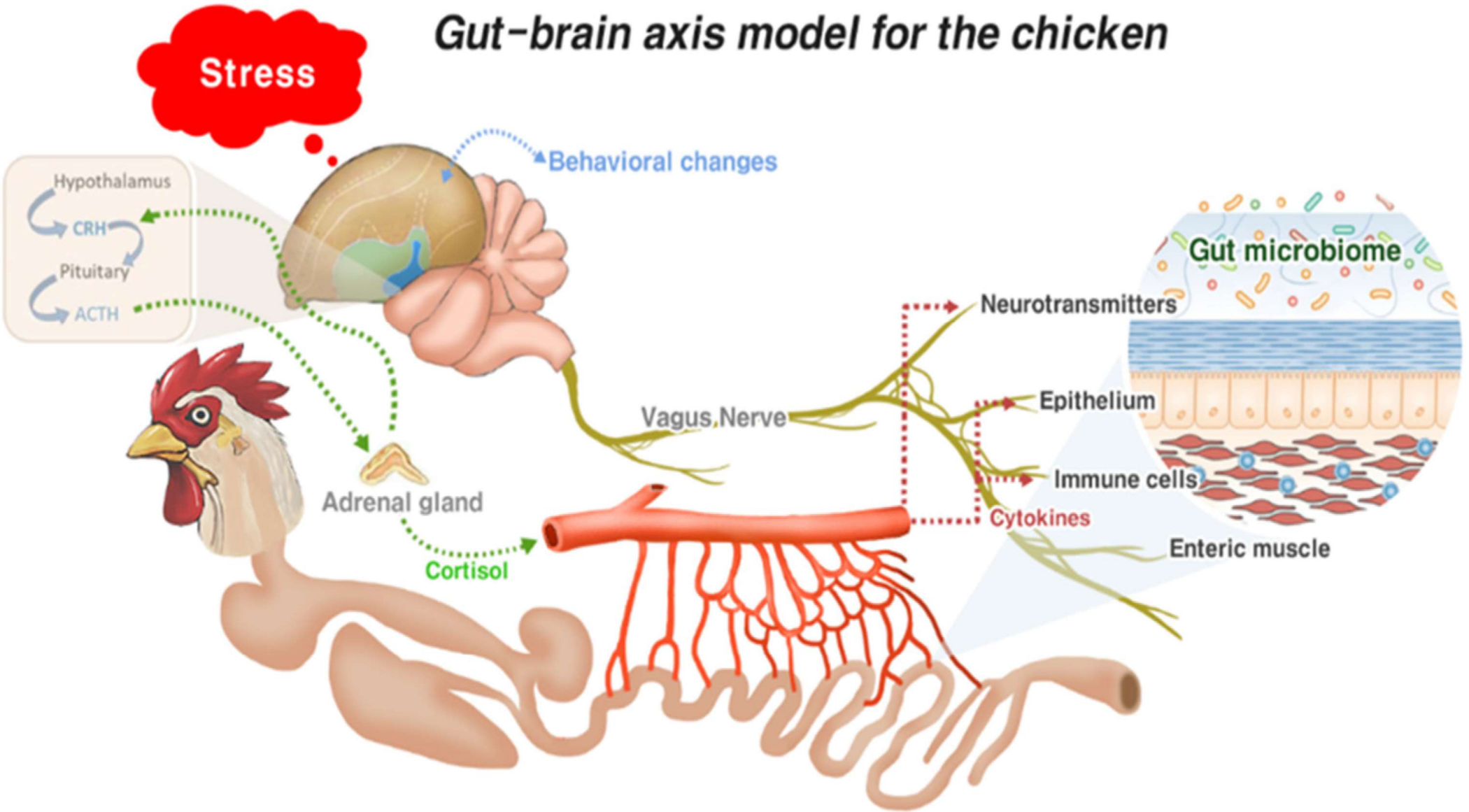
Variation

Helicopter birds



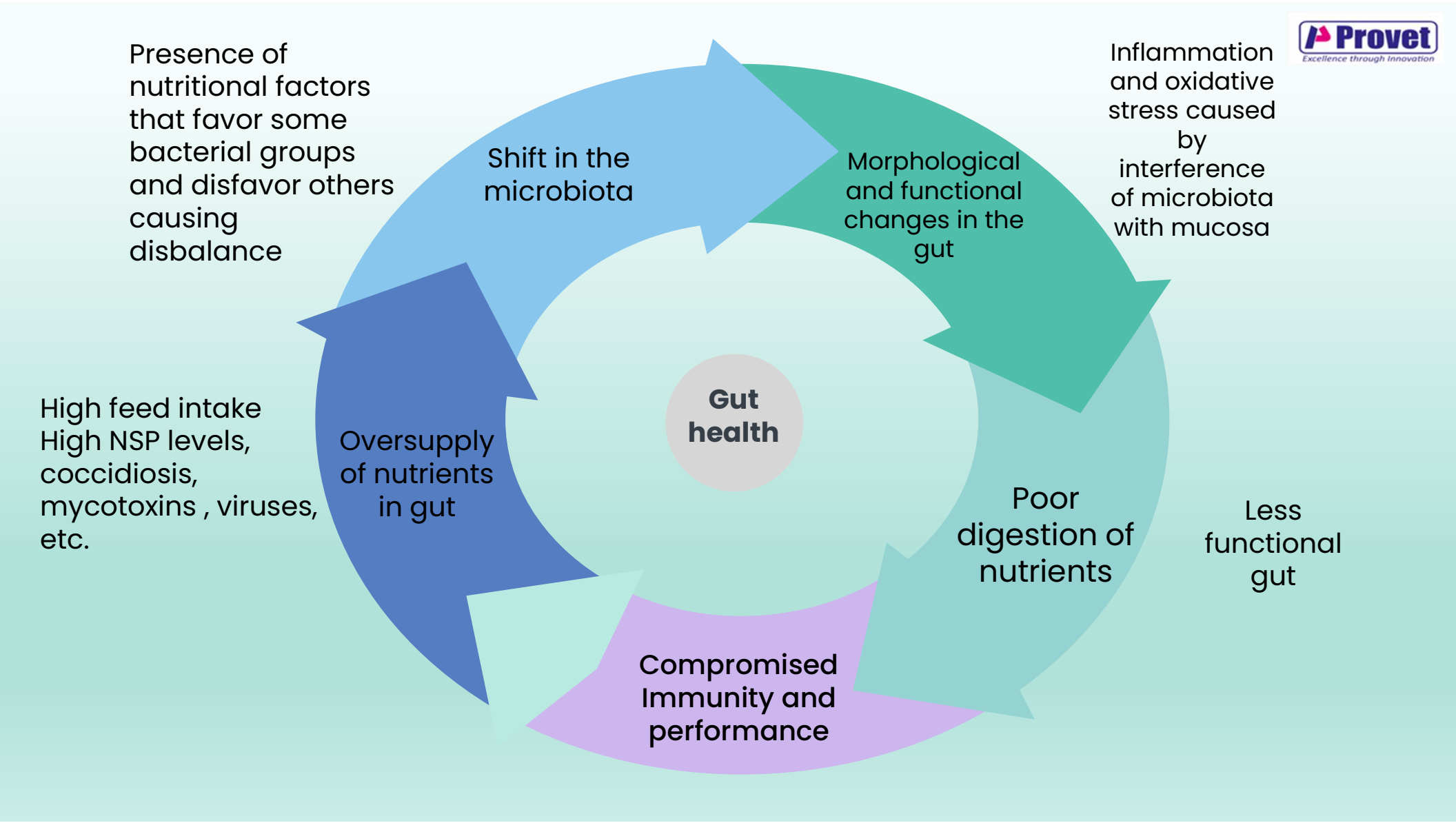
Proventriculitis


Clinical coccidiosis and Bacterial enteritis
Sub-Clinical coccidiosis and Bacterial enteritis


Gut-brain axis model for the chicken
Stress
Behavioral changes
Hypothalamus
CRH
Pituitary
ACTH
Vagus Nerve
Adrenal gland
Cortisol
Gut microbiome
Neurotransmitters
Epithelium
Immune cells
Cytokines
Enteric muscle

GUT BRAIN AXIS

- It plays a responsible role in mediating neural, immunological, and hormonal signaling.
- When chickens encounter enteric stress or inflammation, transmit signals to the brain via the central nervous system (vagus nerve) and increase the serum corticosterone levels.
- Corticosterone modulates heterophile migration to attune inflammation.
- A combination of decreased feed intake, weight loss, decreased movement, and increased sleepiness is considered as sickness behavior in chickens.
- But due to genetic selection these chicken continue eating and end up with dysbiosis.


Presence of nutritional factors that favor some bacterial groups and disfavor others causing disbalance
Shift in the microbiota
Morphological and functional changes in the gut
Inflammation and oxidative stress caused by interference of microbiota with mucosa
High feed intake
High NSP levels, coccidiosis, mycotoxins , viruses, etc.
Oversupply of nutrients in gut
Gut health
Poor digestion of nutrients
Less functional gut
Compromised Immunity and performance


Solution

ANTIBIOTIC GROWTH PROMOTERS

- BMD/ ZINC BACITRACIN
- ENRAMYCIN
- AVILAMYCIN ?
- VIRGINIAMYCIN ?
- FURAZOLODINE ?
- CTC/OTC ?
- MACROLIDES ?
- TIAMULIN ?
- BAMBERMYCIN
- Anticoccidials

SOLUTIONS

NON ANTIBIOTIC GROWTH PROMOTERS

- PROBIOTICS
- PREBIOTICS
- SYNBIOTICS
- ESSENTIAL OILS
- ENZYMES
- ORGANIC ACIDS
- BACTERIOPHAGES
- LYSOZYMES
- LACTOFERRINS
- BACTERIOCINS
- ANTIMICROBIAL PEPTIEDE
- POSTBIOTICS

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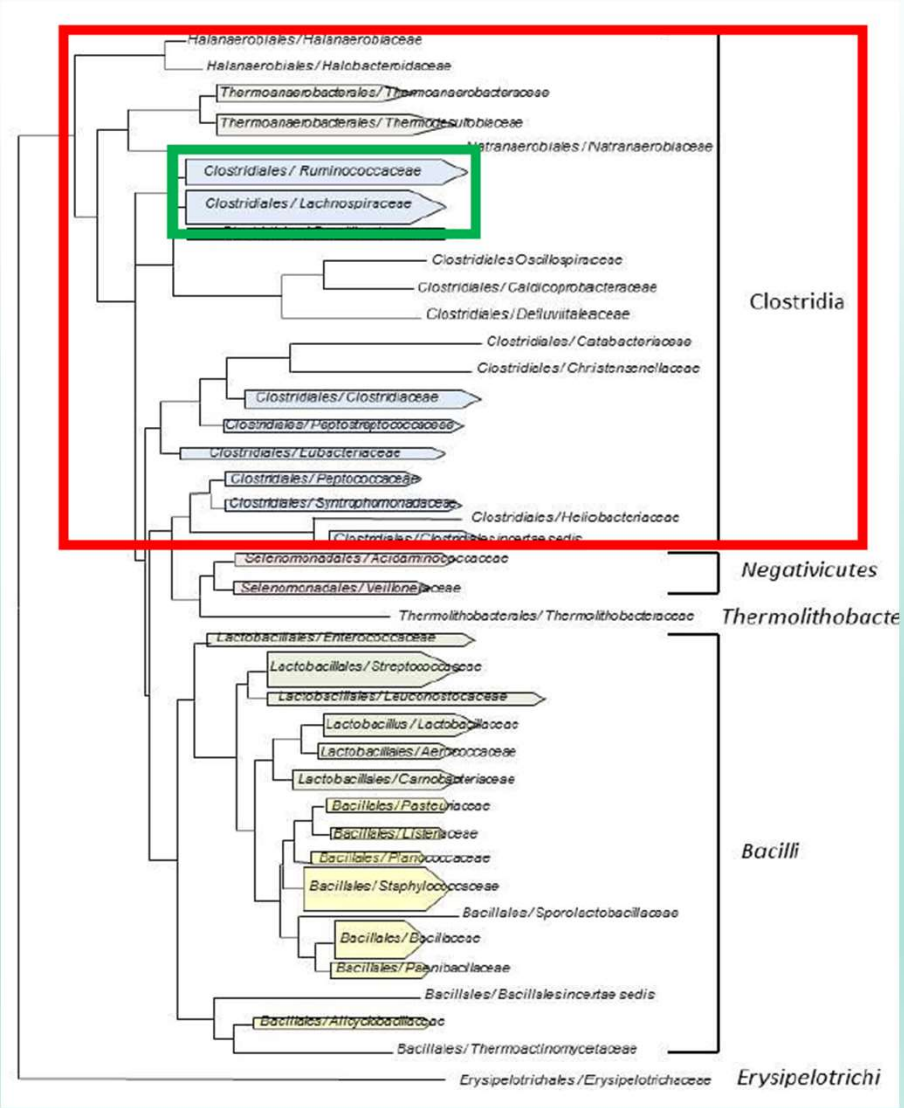


Are all Clostridia bad?

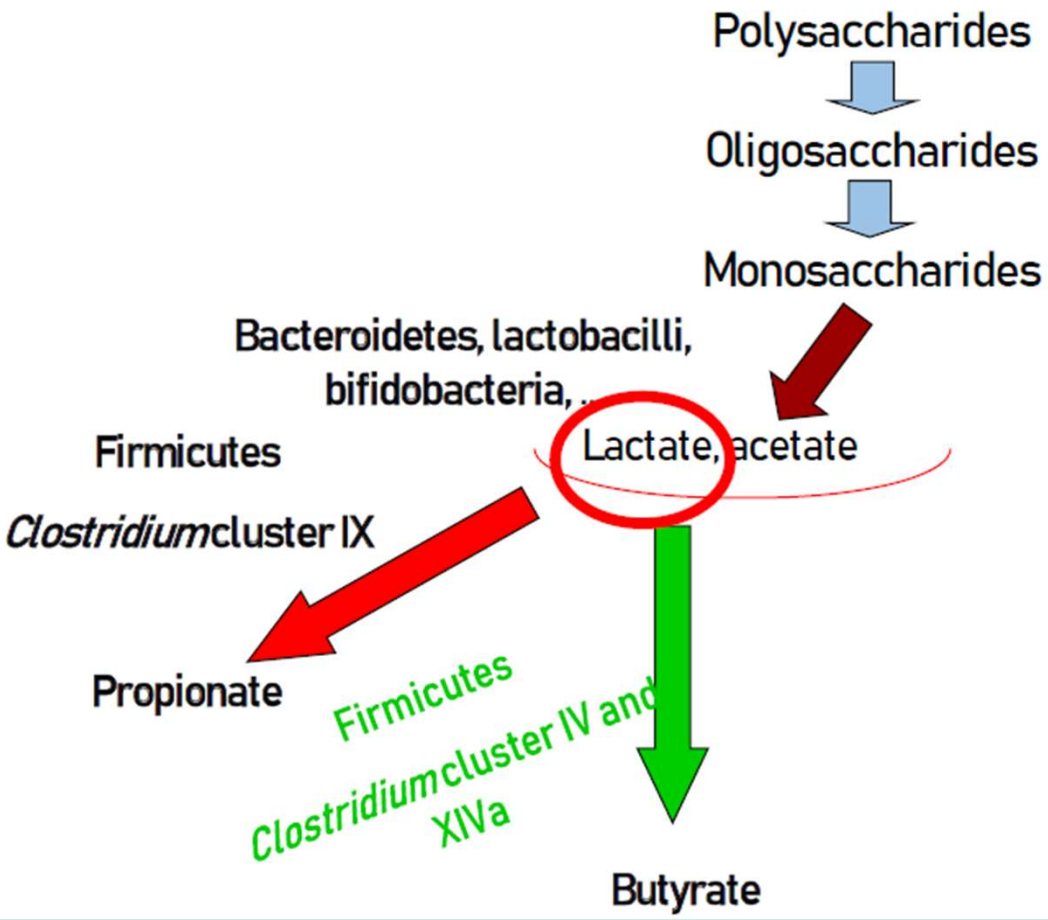
Are all Bacilli good?

- There is domination of lactic producing microbiome in the gut, but high quantity of lactic acid is toxic for the enterocytes.

- Some species of *Clostridium* will use this lactic acid as substrate and convert them into Butyric acid which is a preferred source of energy for the enterocytes.

- Excessive usage of AGPs will eliminate these harmless Clostridium.

METABOLISM OF CARBOHYDRATE

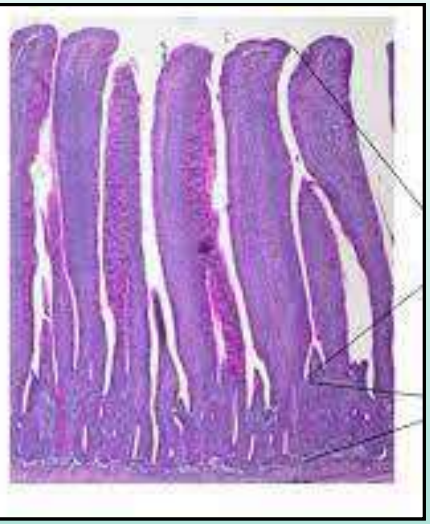


Effects of D-(Lactate)

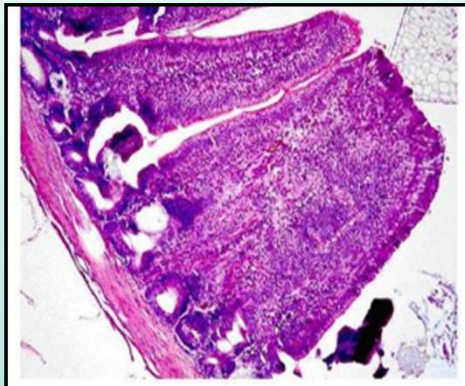
- Production increases
  - Butyrate
  - Propionate

Van Immerseel

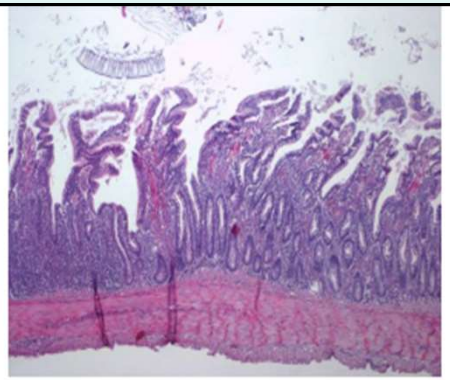
EFFECT OF DYSBIOSIS/BACTERIAL ENTERITIS



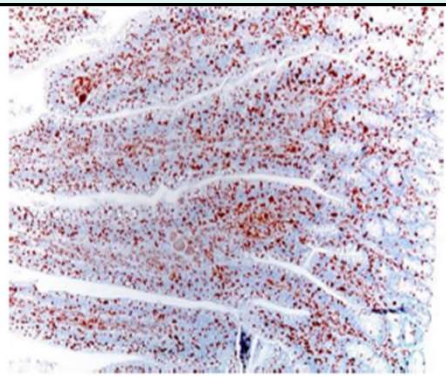
Healthy villi



Vilus fusion



Decreased vilus length
Larger crypts



Infiltration of T-lymphocytes and heterophils


Spore forming & Non
spore forming probiotics

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Soaking in water

Germination of spores

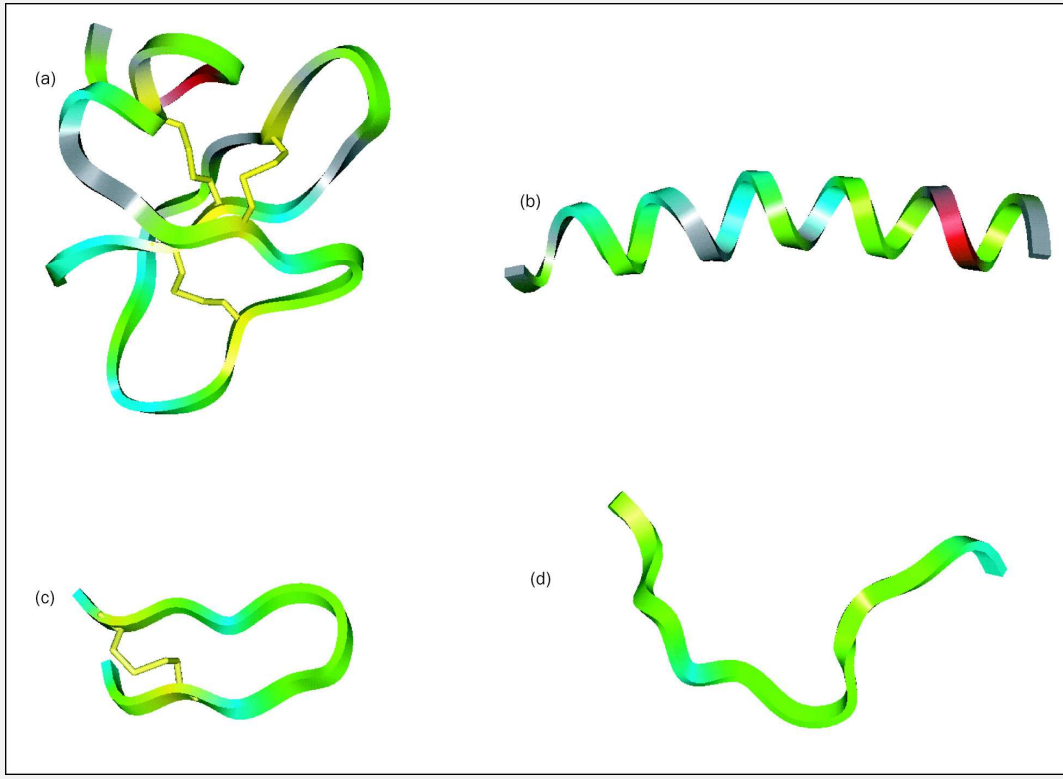
Production of antimicrobial peptides by probiotics

Non ribosomal –

1. Fengycins
2. Iturins
3. Surfactins
4. Bacillaenea
5. Difficidin
6. Transtheptin

Ribosomal –

1. Bacteriosins CL-I, CL-II, CL-III
2. Quorum quenching enzymes
3. Lytic enzymes



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Synthesis of short chain fatty acids

1. Acetic acid
2. Propionic acid
3. Butyric acid

Synthesis of other metabolites

1. H_2O_2
2. ROS
3. RNS

Synthesis of vitamins

1. Vitamin K
2. Vitamin B

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- Postbiotics refers to the metabolic byproducts like enzymes, peptides, teichoic acid, peptidoglycan derived muropeptides, exopolysaccharides, cell surface and secreted proteins, bacteriocins and organic acids, generated by a probiotic organism during the final or intermediate stage of its metabolic process (*Tsilingiri et al., 2012; Konstantinov et al., 2013*).

- They can even be vitamins B and K, amino acids, and antimicrobial peptides that help to slow down the growth of harmful bacteria.

- The probiotics like *Lactobacillus*, *Bifidobacterium*, *Streptococcus*, *Eubacterium*, *Faecalibacterium*, and *Saccharomyces* can produce postbiotics.

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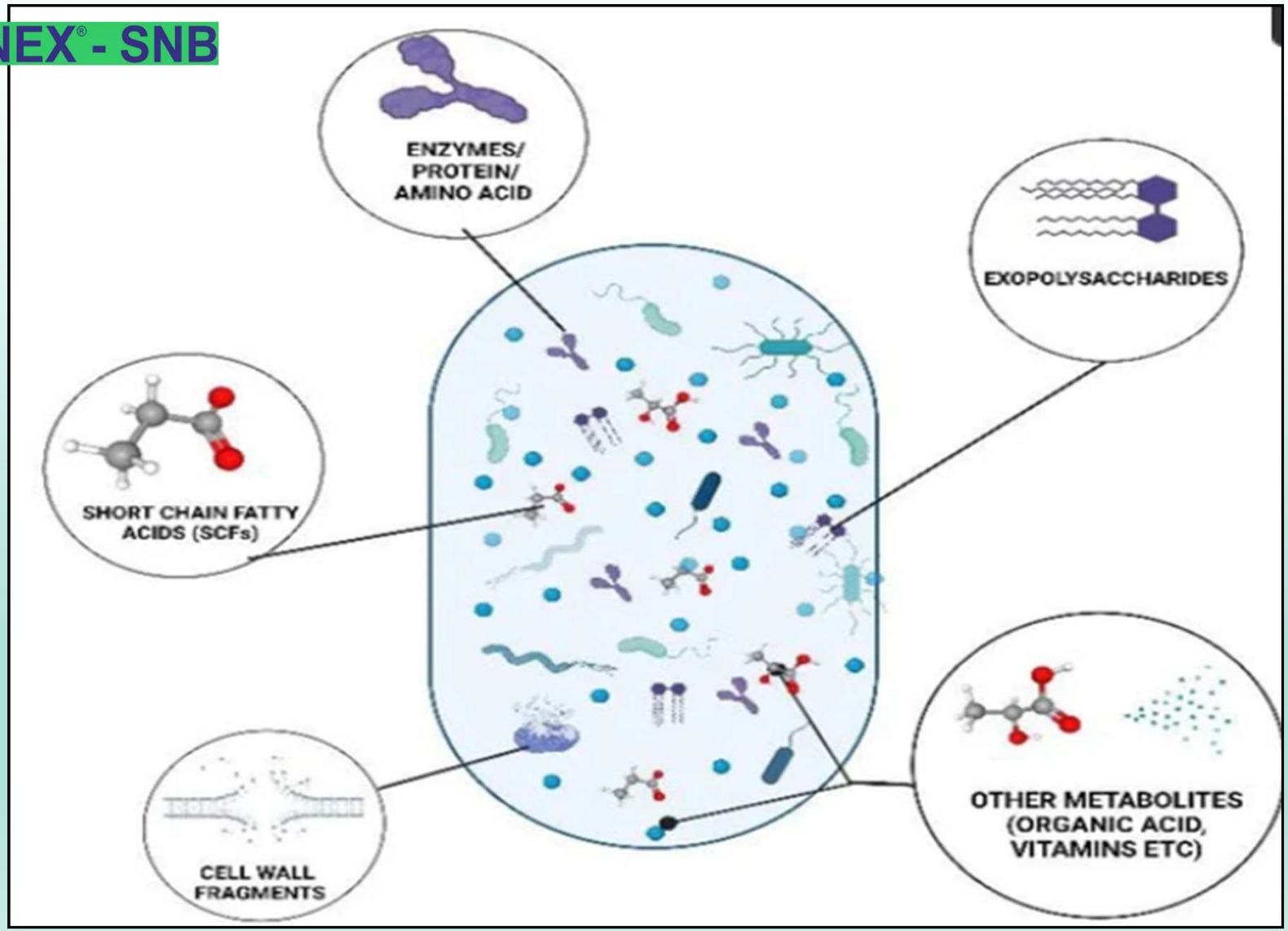

Leaky gut

Healthy gut

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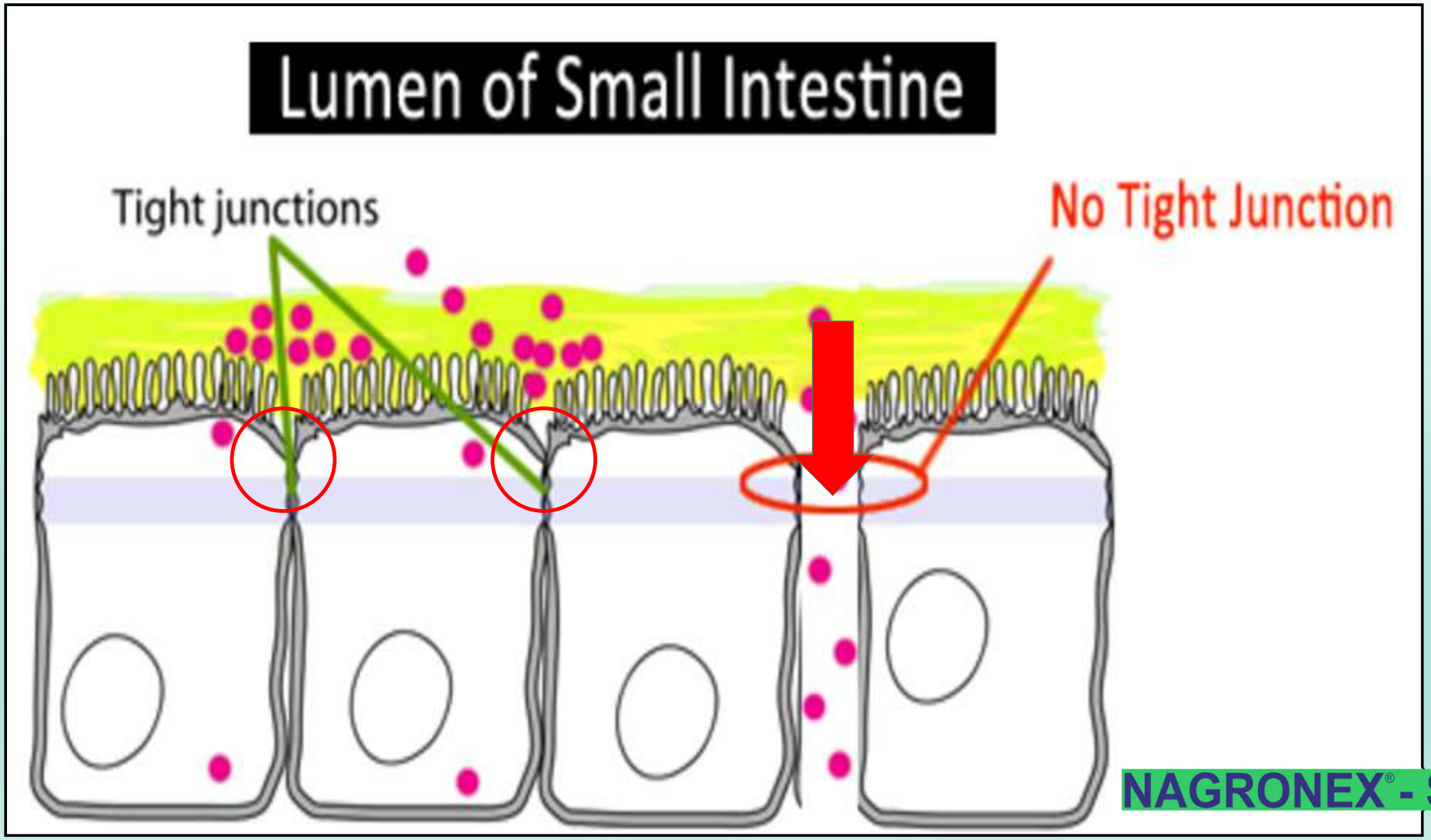
Lumen of Small Intestine
Tight junctions
No Tight Junction

QUOROM SENSING BY THE PATHOGENIC BACTERIA

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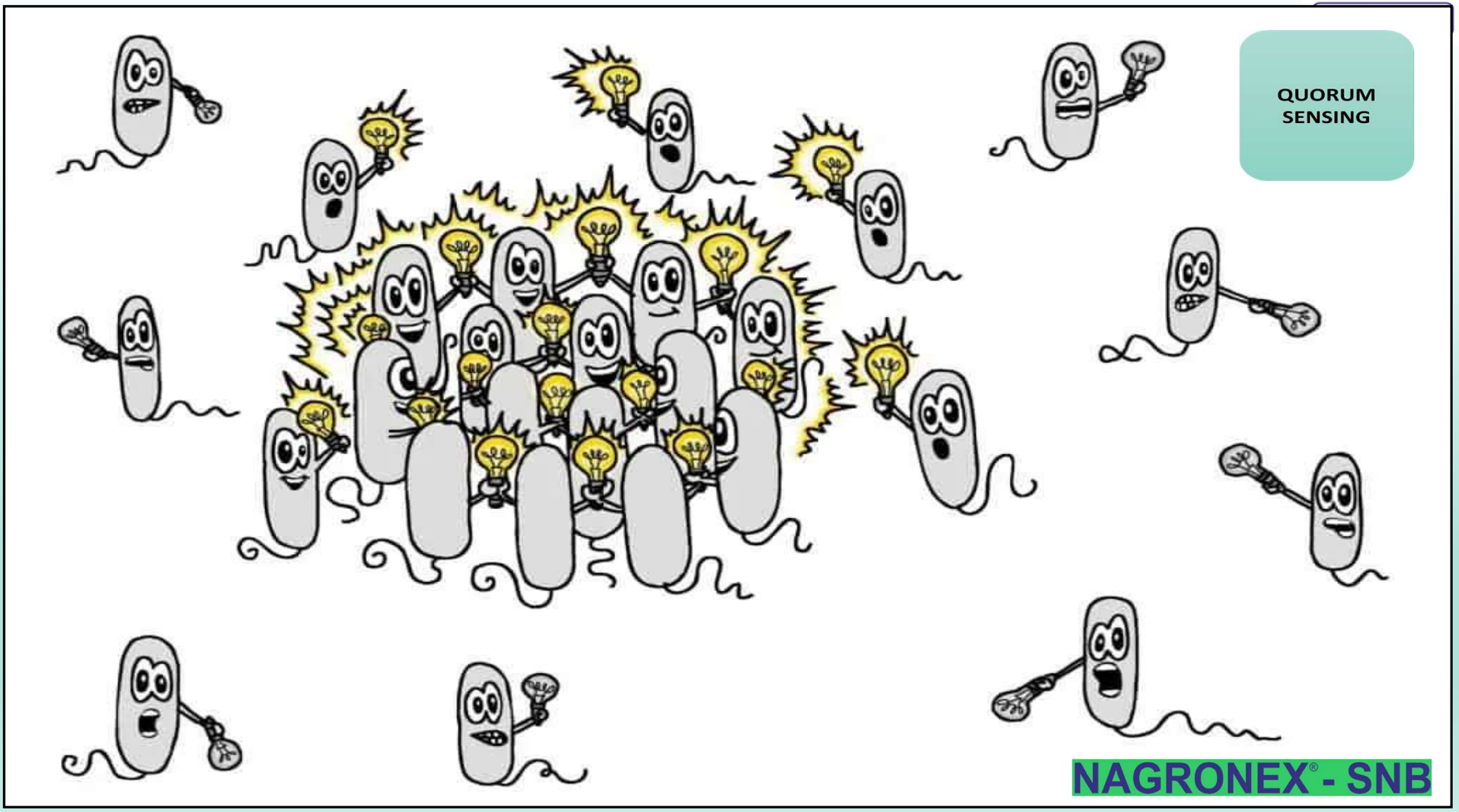
QUORUM
SENSING
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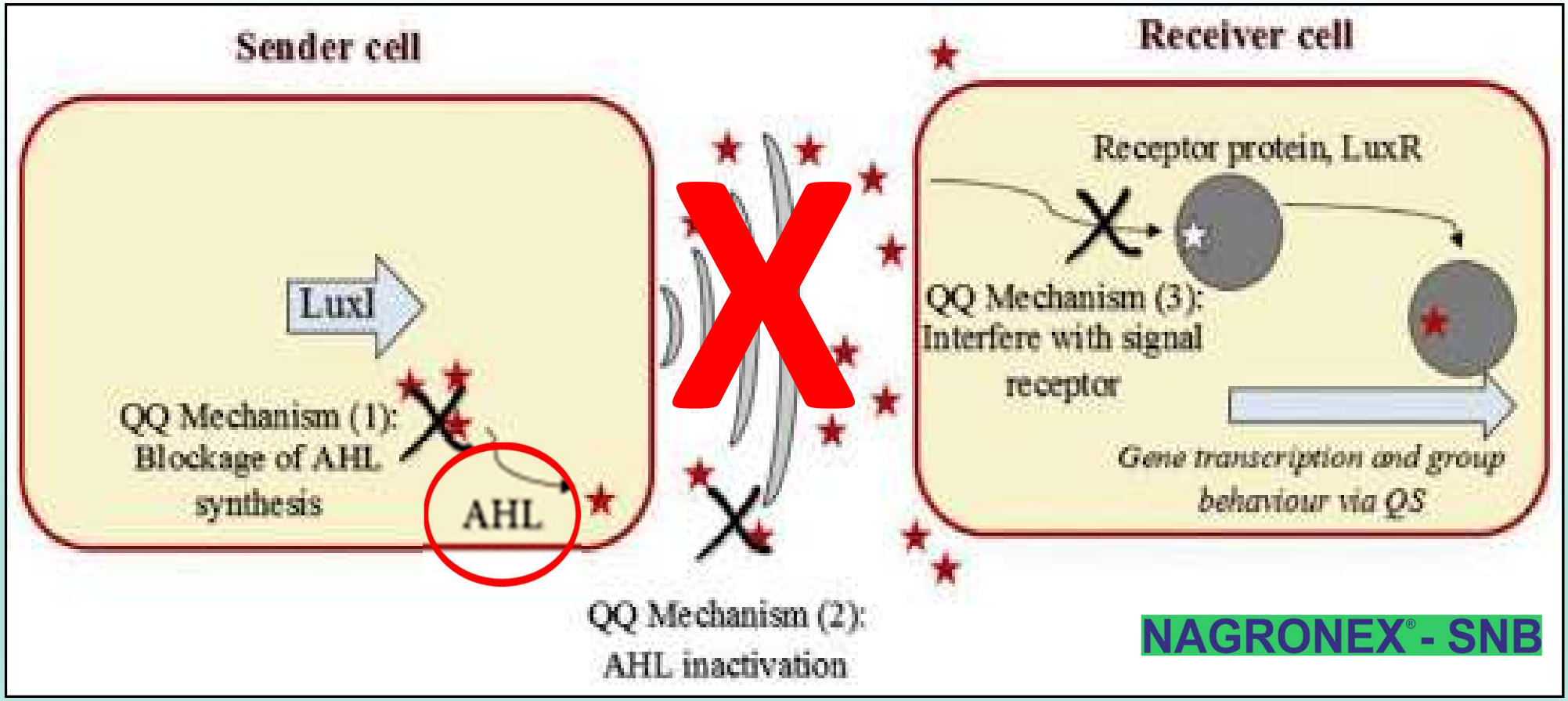
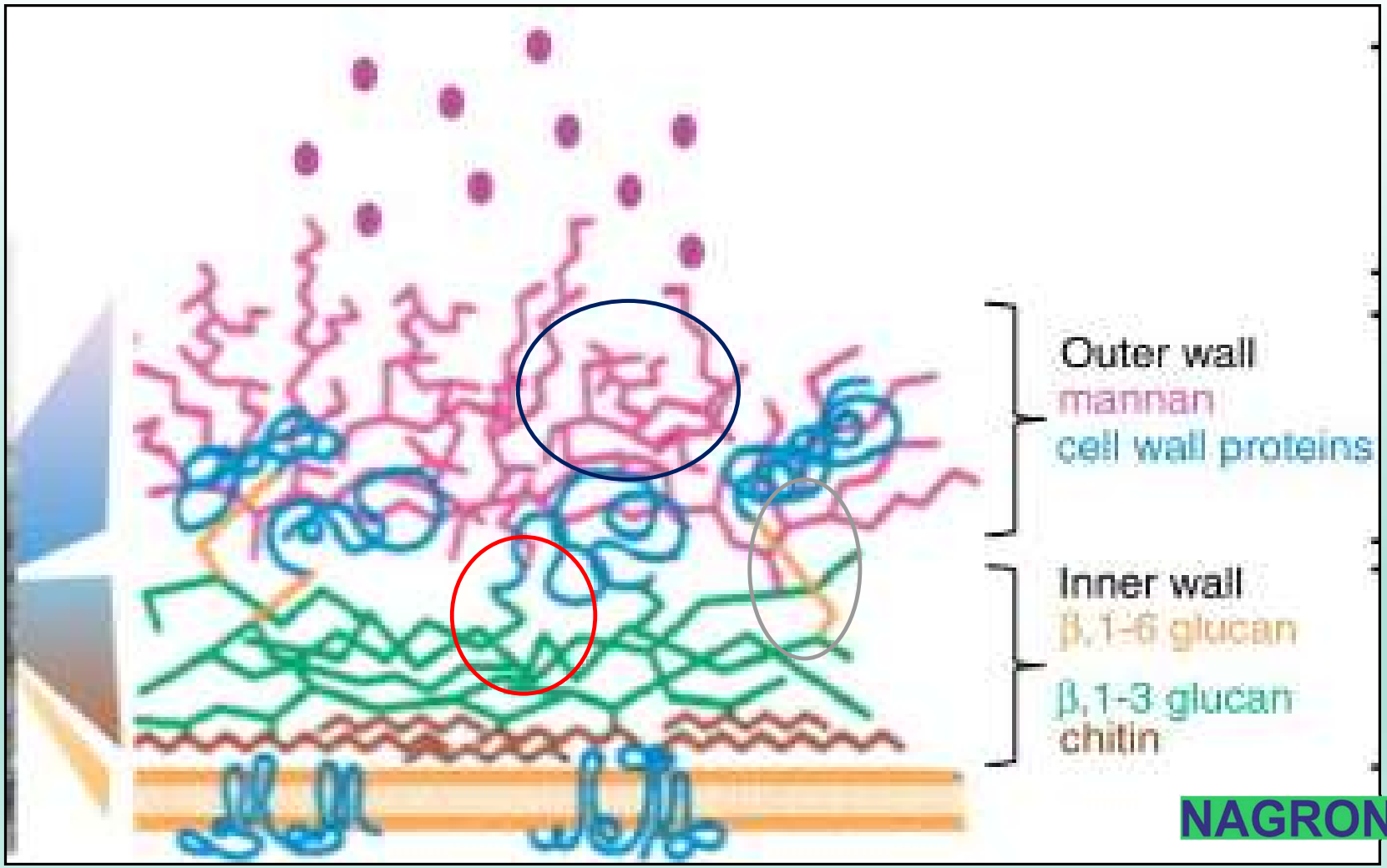
QUORUM QUENCHING BY PROBIOTICS



Extracellular proteases and hemolysin production, cytotoxicity

SACCHROMYCES CEREVISIAE (YEAST *)* CELL WALL



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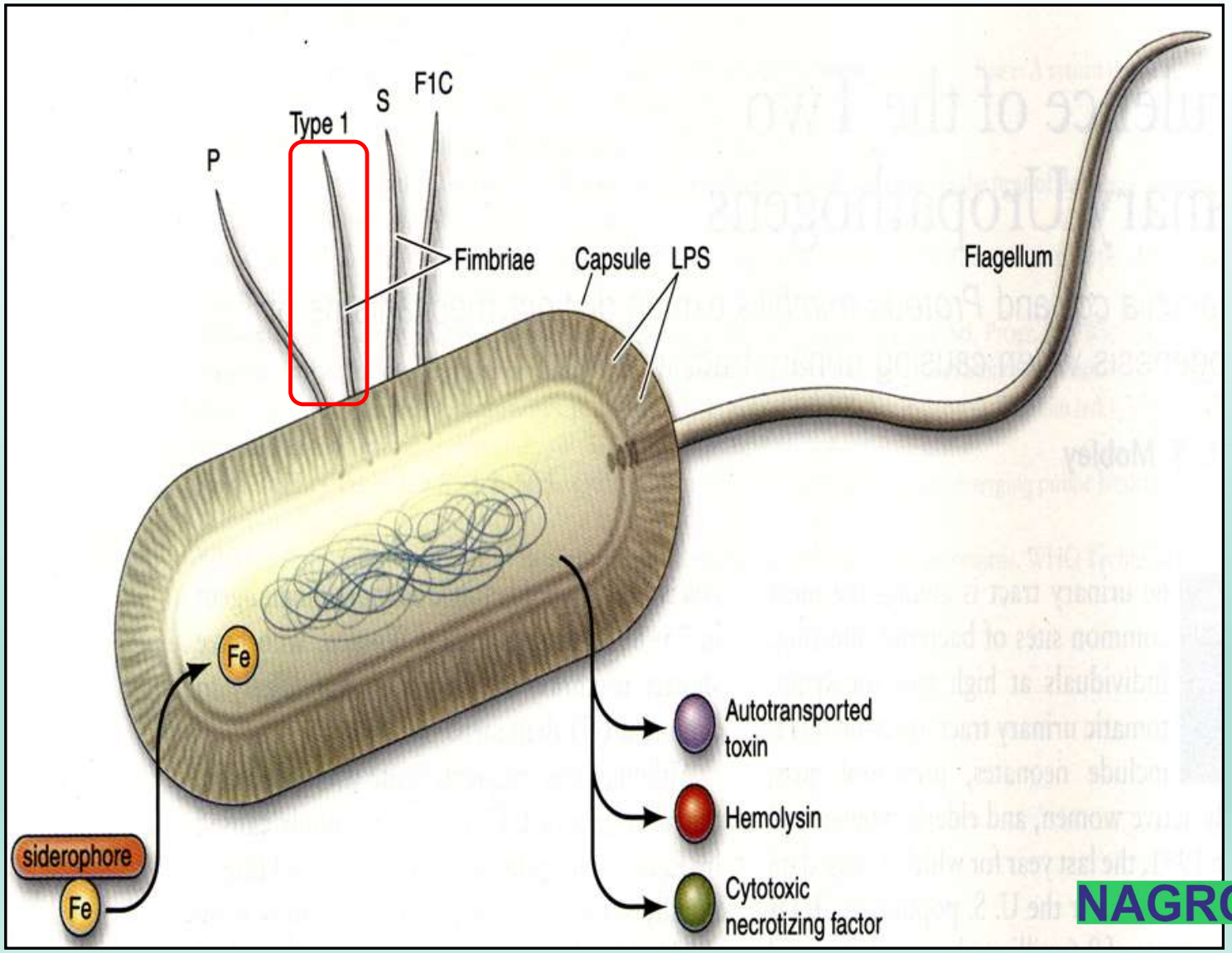

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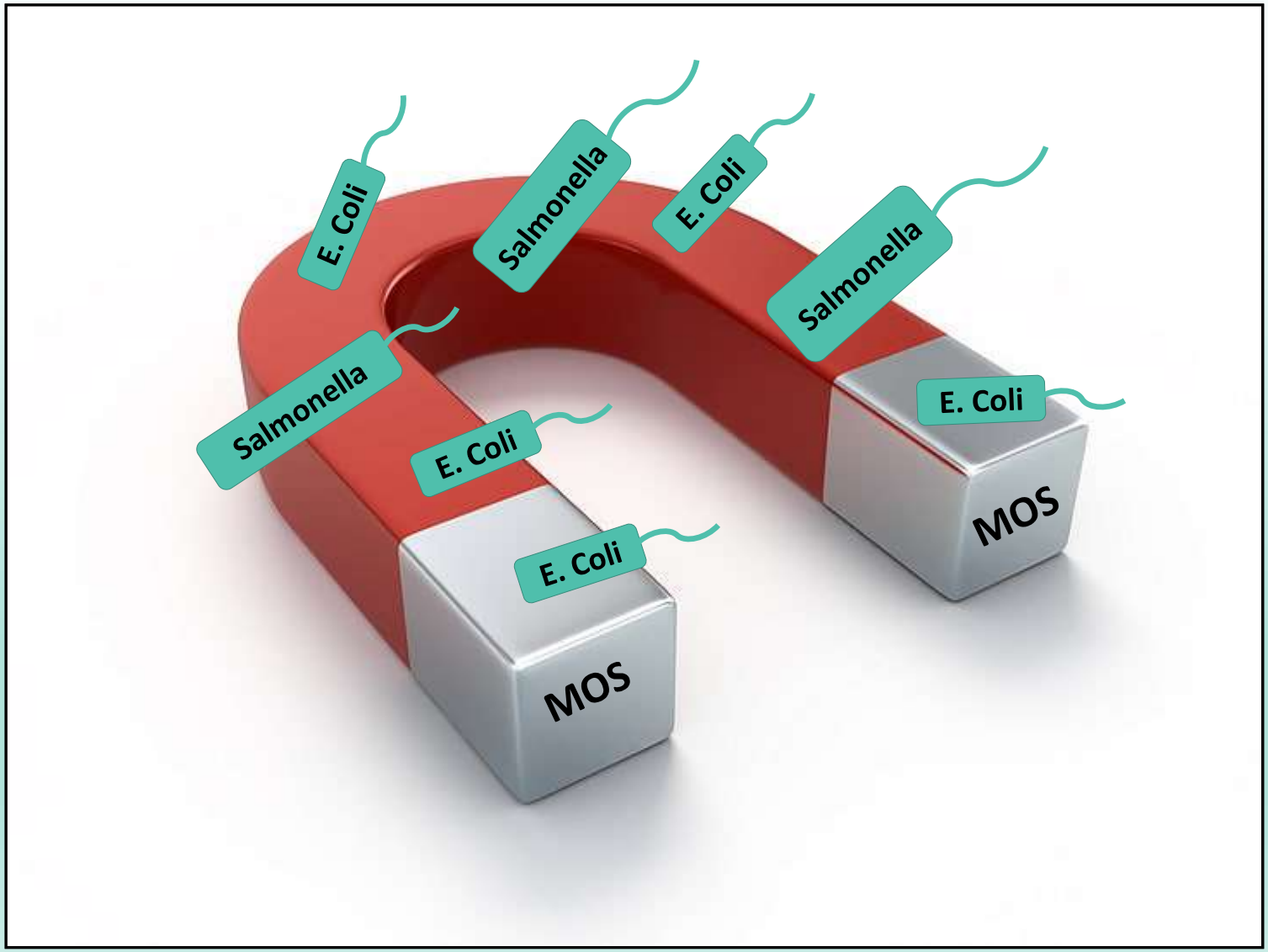

Agglutination of *E. Coli* and Salmonella

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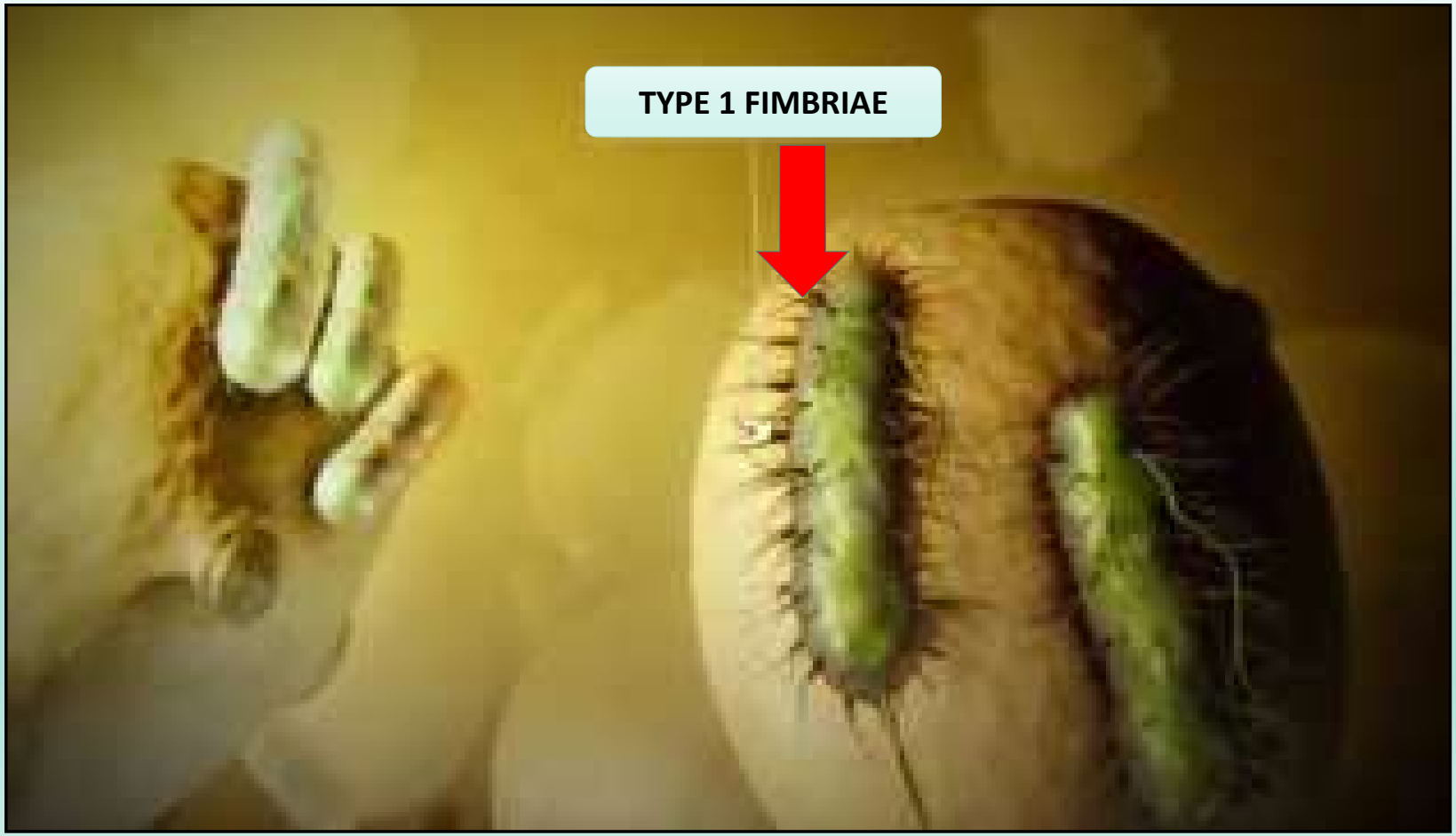
MOS MODE OF ACTION

PATHOGEN AGGLUTINATION WITH TYPE 1 FIMBRIAE

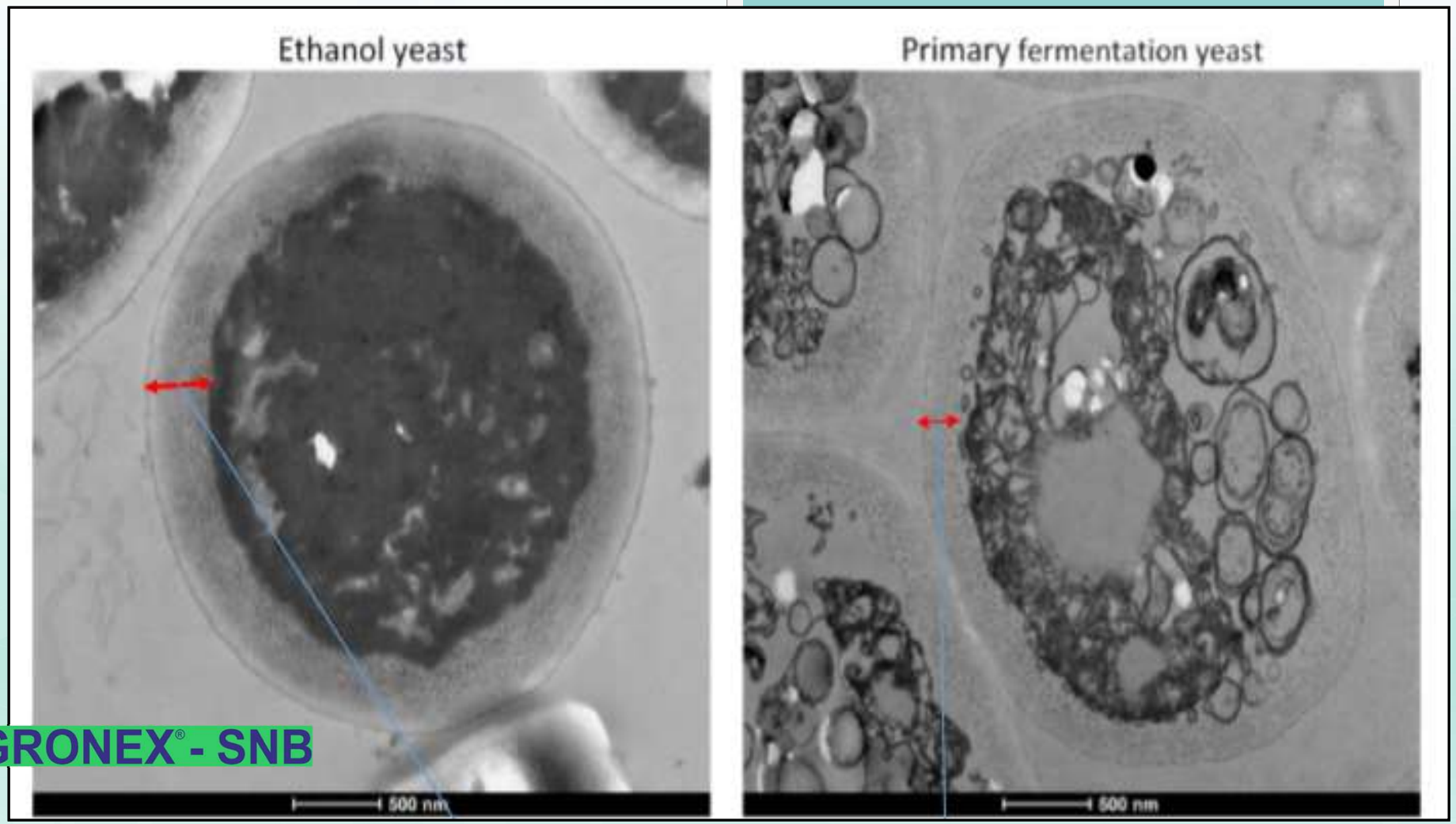


Thin cell wall v/s thick cell wall

- **Baker's yeast cell walls ~ 70% digestibility in gut and less functional.**
- **Baker's yeast cell wall thickness ~ 54 Nm (*A. Bzducha, June 12*)**

- **Ethanol based yeast cell walls ~ 30% digestibility in gut and more functional**
- **Ethanal based yeast cell wall thickness ~ 200 Nm (*Frans M Klis Sep 2002*)**

Ethanol based V/S Baker's yeast based MOS



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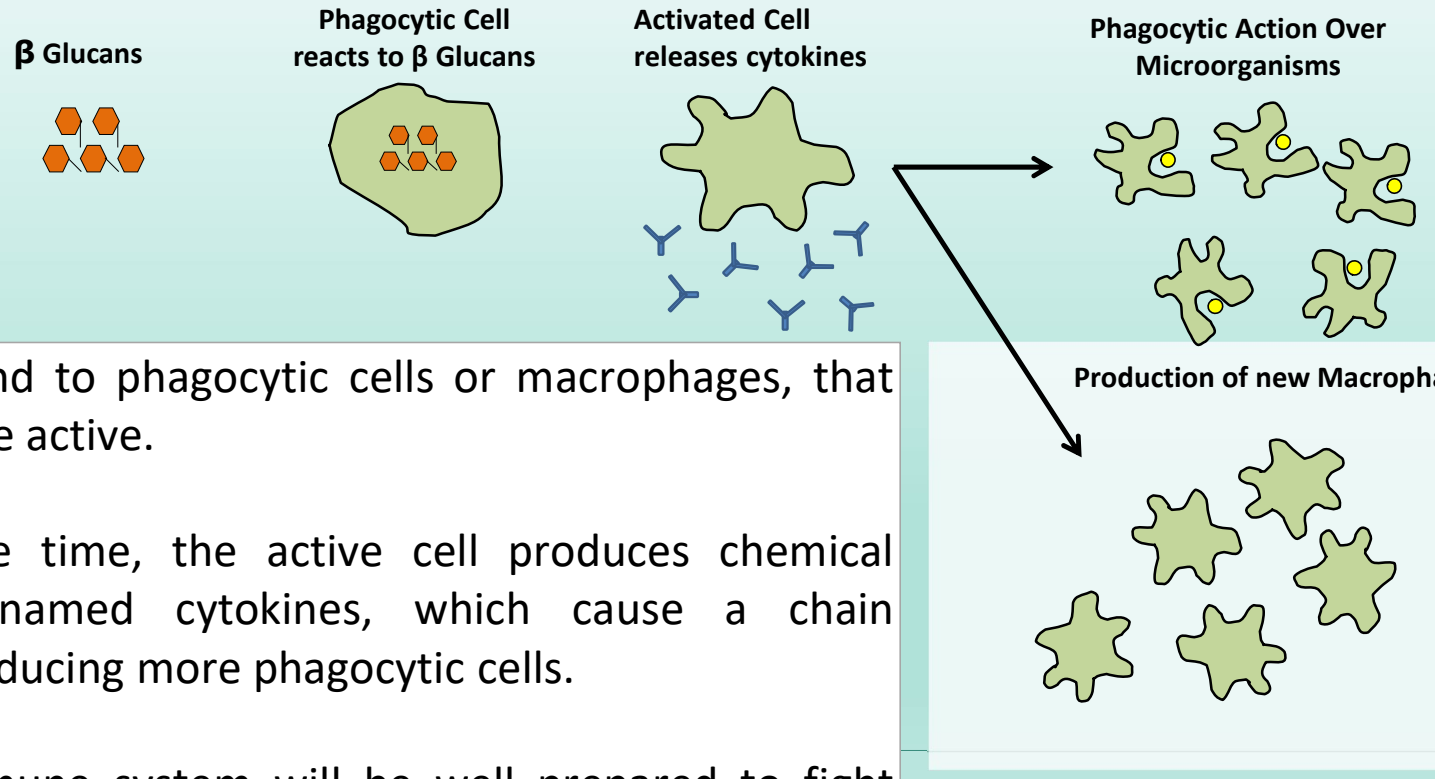
β-Glucans in Action

NON-SPECIFIC IMMUNE SYSTEM OF ANIMALS



- β-glucans bind to phagocytic cells or macrophages, that become more active.
-
- At the same time, the active cell produces chemical substances named cytokines, which cause a chain reaction, producing more phagocytic cells.

- An alert immune system will be well prepared to fight against opportunistic diseases.

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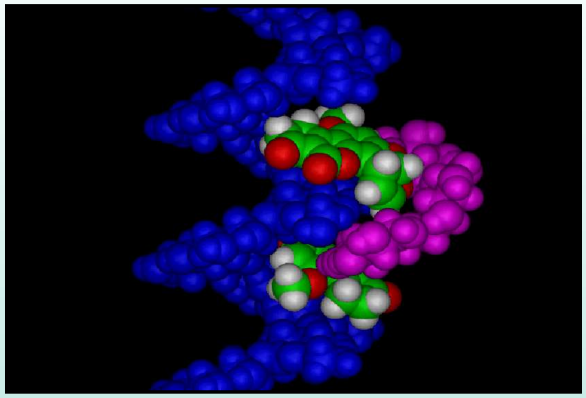
β-Glucans in Action

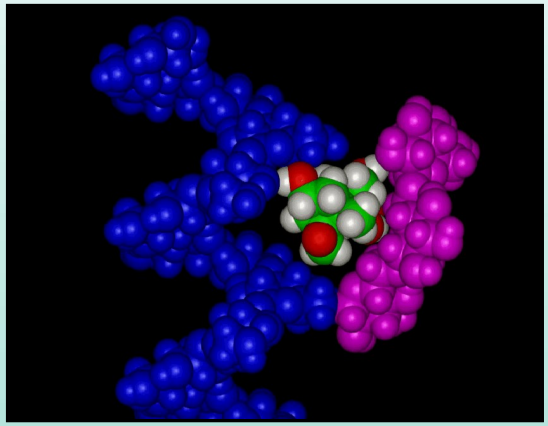


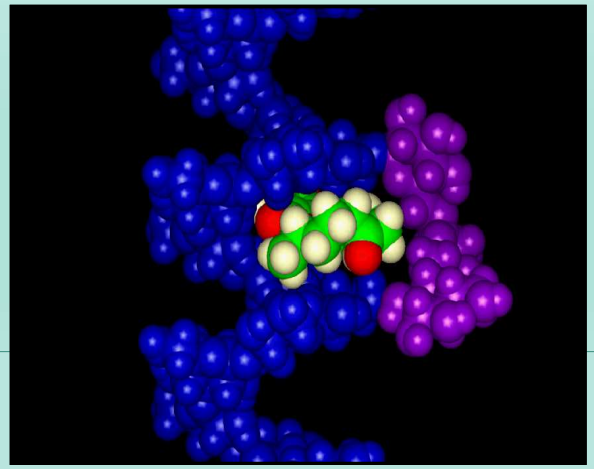
Interaction –
β-glucans vs. Aflatoxin B1

Mycotoxins Adsorption

β-glucans (**in blue**) bind to either polar, non-polar and bi-polar mycotoxins through hydrogen and Van der Waals bonds interactions and will later be eliminated.

Interaction –
β-Glucans vs. DON





Interaction –
β-Glucans vs. Zearalenone

β Glucans of different origin

Beta glucan type	Structure	Description
Bacterial		Linear β–1,3–glucan (Curdlan)
Cereal		Linear β–1,3 / 1,4–glucan (i.e. oats, barley, rye)
Fungal		Short β–1,6 branched β–1,3–glucan (i.e. mushroom)
Yeast		Long–β–1,6 branched β1,3–glucan (Yeast beta–glucan)

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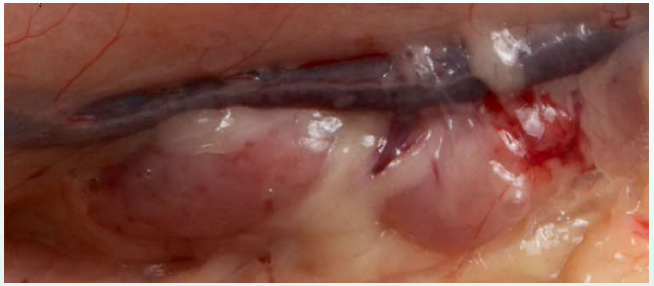
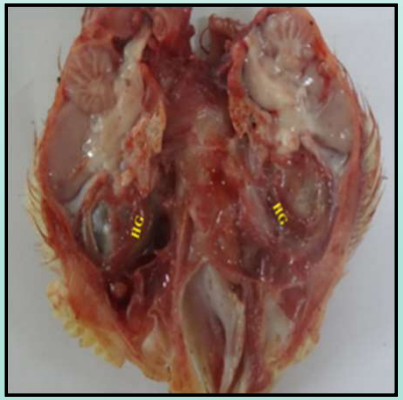


Thymus

Bursa

SPLEEN



Harderian gland

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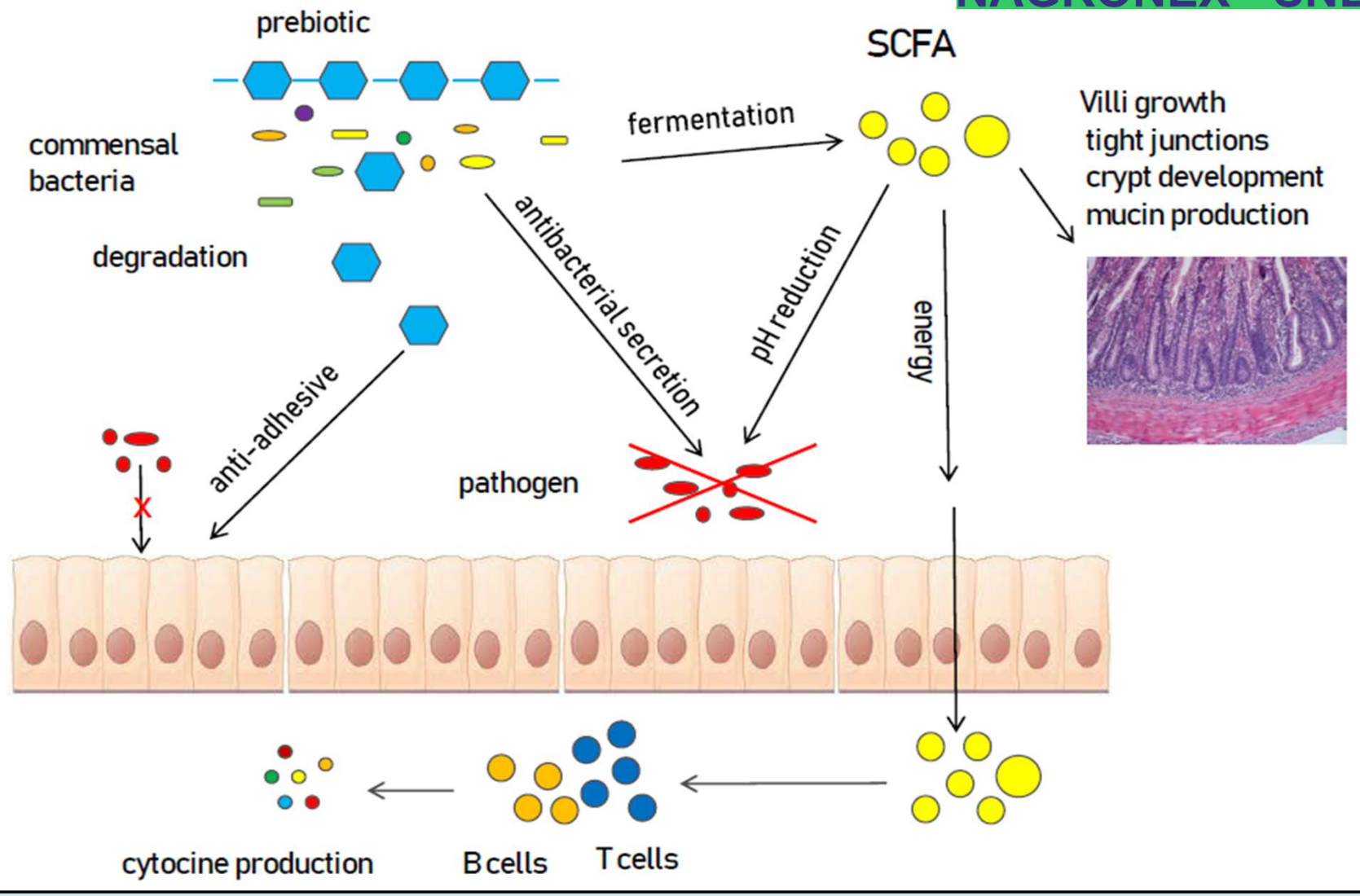
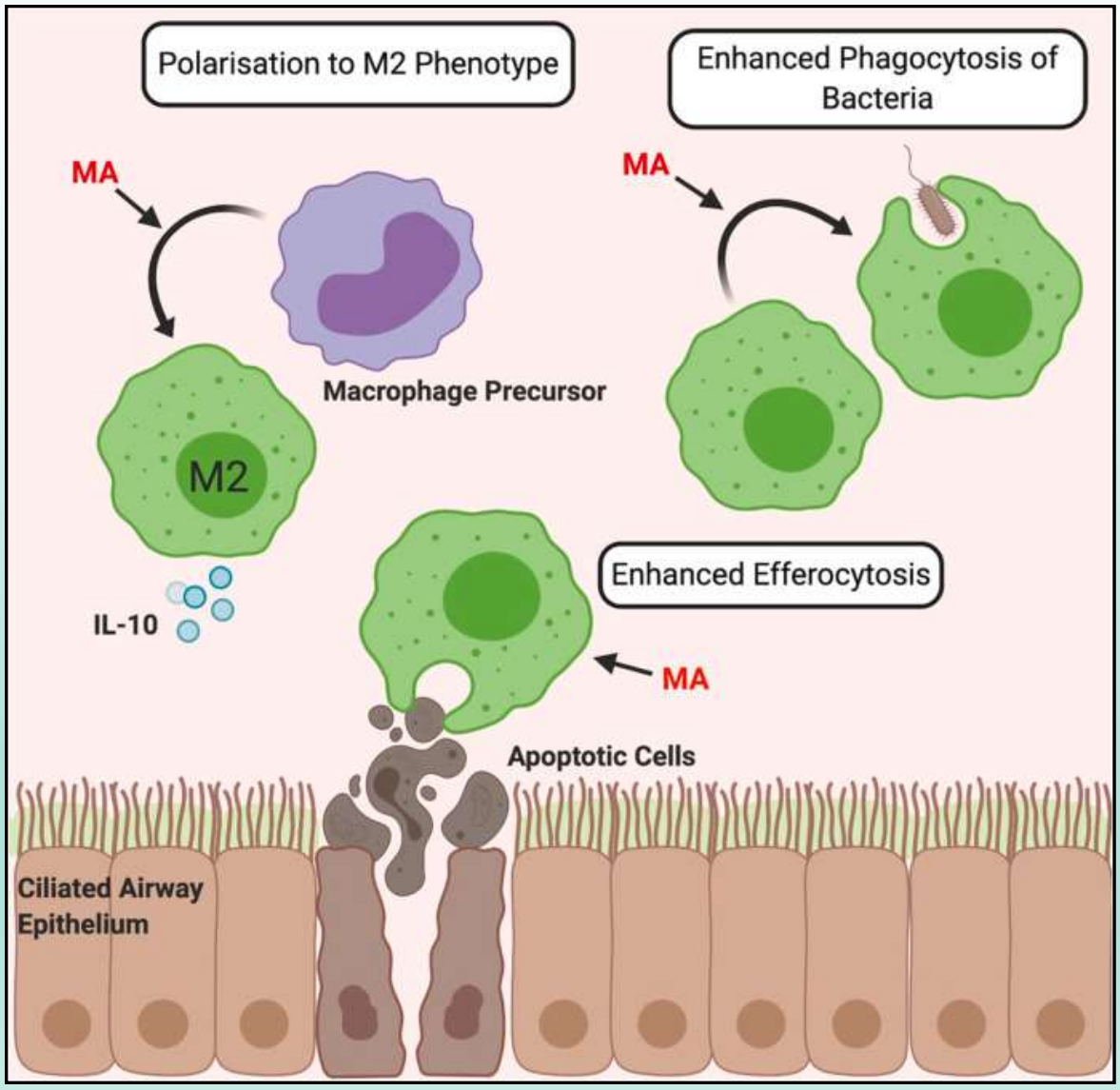
direct effect

effect on microflora

effect on bacterial metabolites

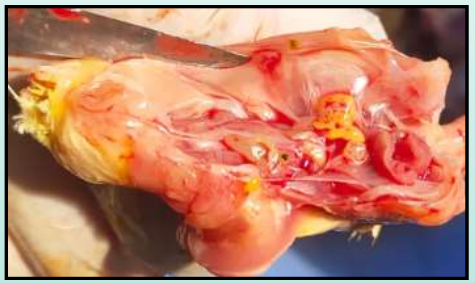


EFFECT OF PREBIOTICS (MOS & β glucans) IN GUT



- Macrolide antibiotics tends to accumulate in macrophages. (*B. Scorneaux and T R Shryock, Poultry science, Oct 1998*).
- Macrophages, monocyte macrophages and heterophils has good concentration of macrolide antibiotics even after withdrawal.
- There will be increase in macrolide and phagocyte interaction to contribute clinical efficacy.



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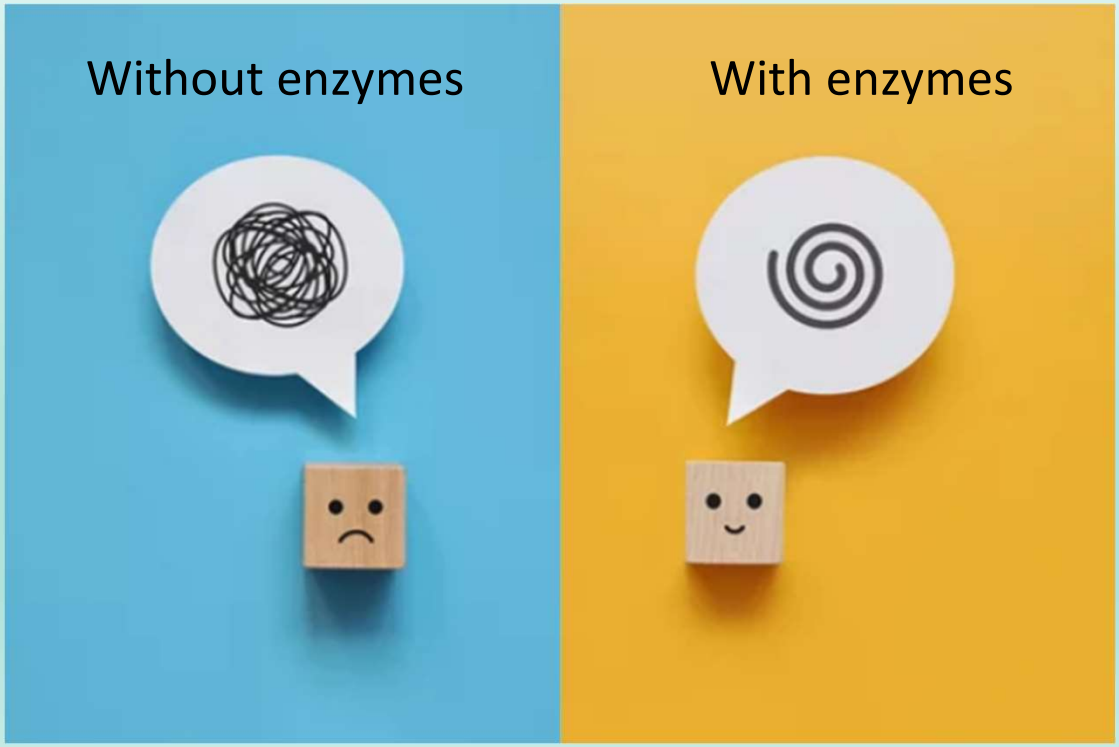
Substrate specific enzymes

1. Xylanase
2. β glucanase (in case of wheat diets)
3. Mannanase
4. α galactosidase
5. Protease
6. Phytase
7. Multienzymes



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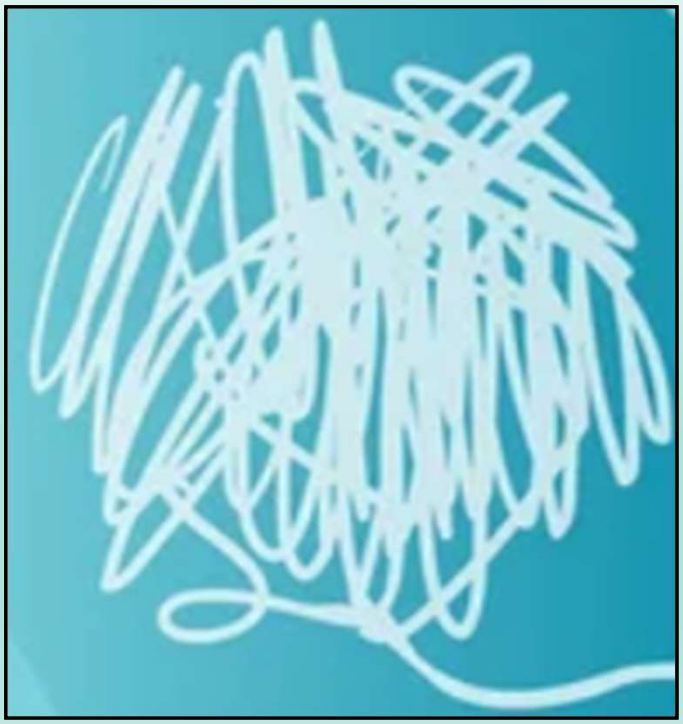
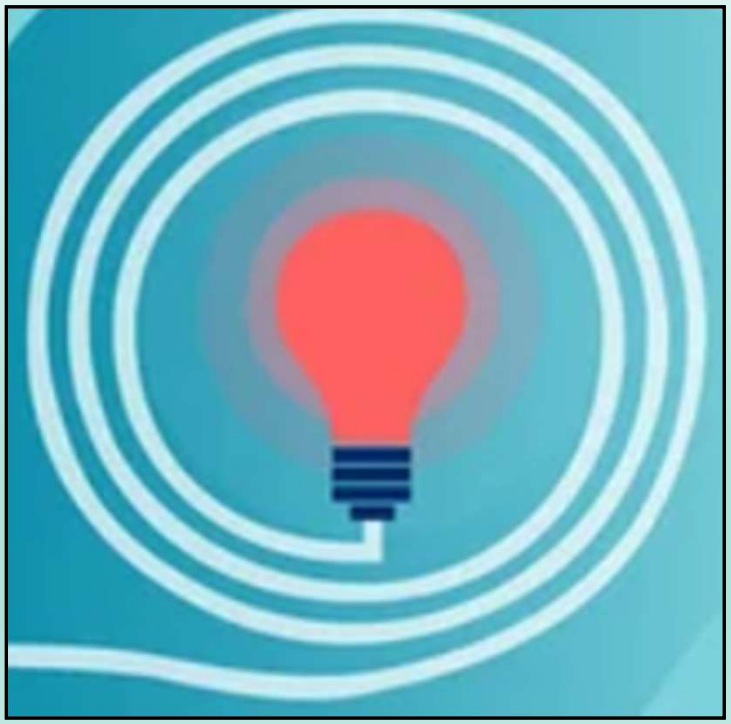
Intestinal viscosity

Soluble and partially soluble fiber



ENZYMES



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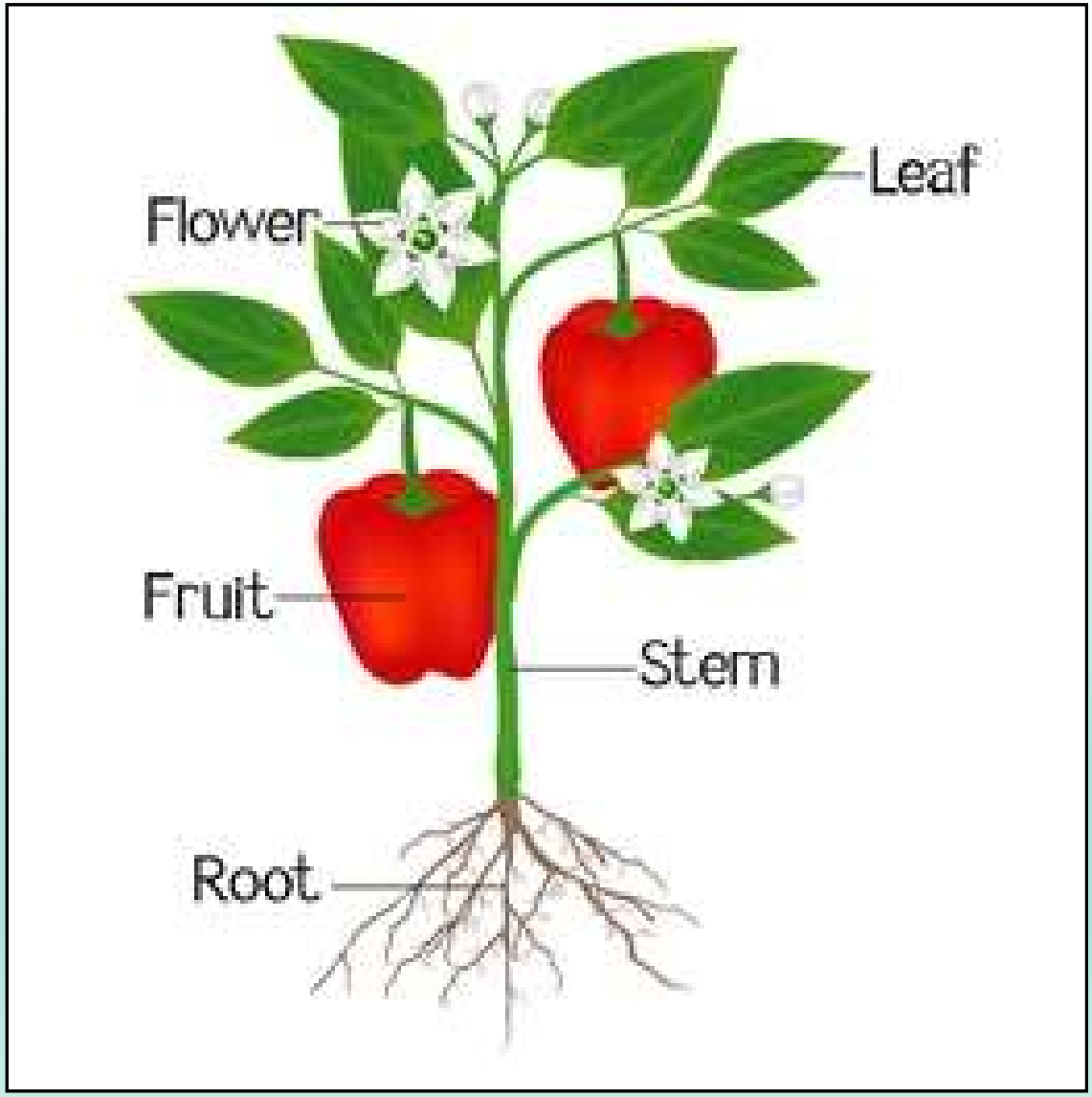
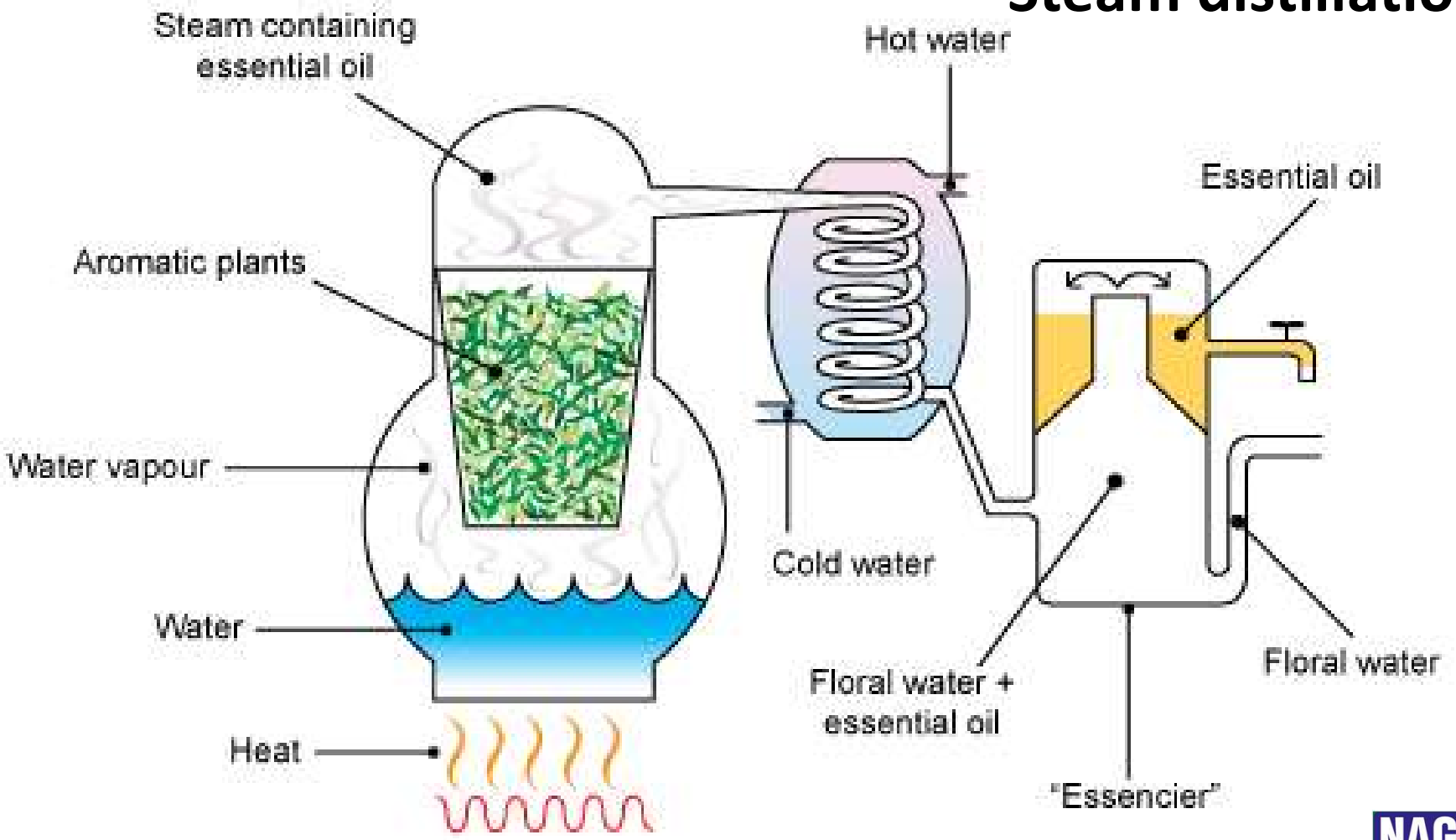
HERBAL V/S ESSENTIAL OILS

Essential oil yields around 1 - 5 % of wet weight of herbs


Flower
Leaf
Fruit
Stem
Root

Traditional extraction of scent in India

Steam distillation



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Commonly used candidate herbs for extracting essential oil from different part of the plant

Flower

Leaf

Bark

Seed

Bulb

Rhizome

Root

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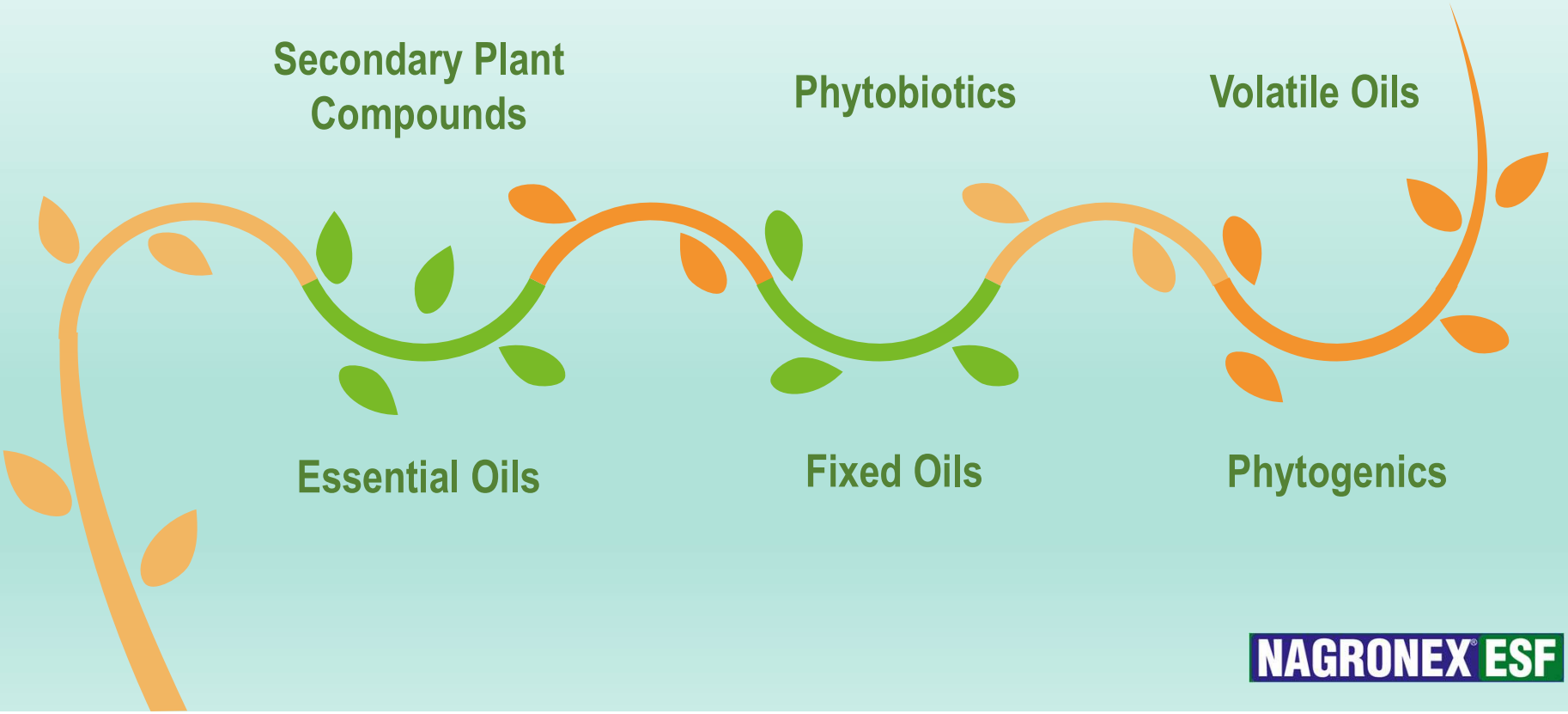
Different Names But One & The Same



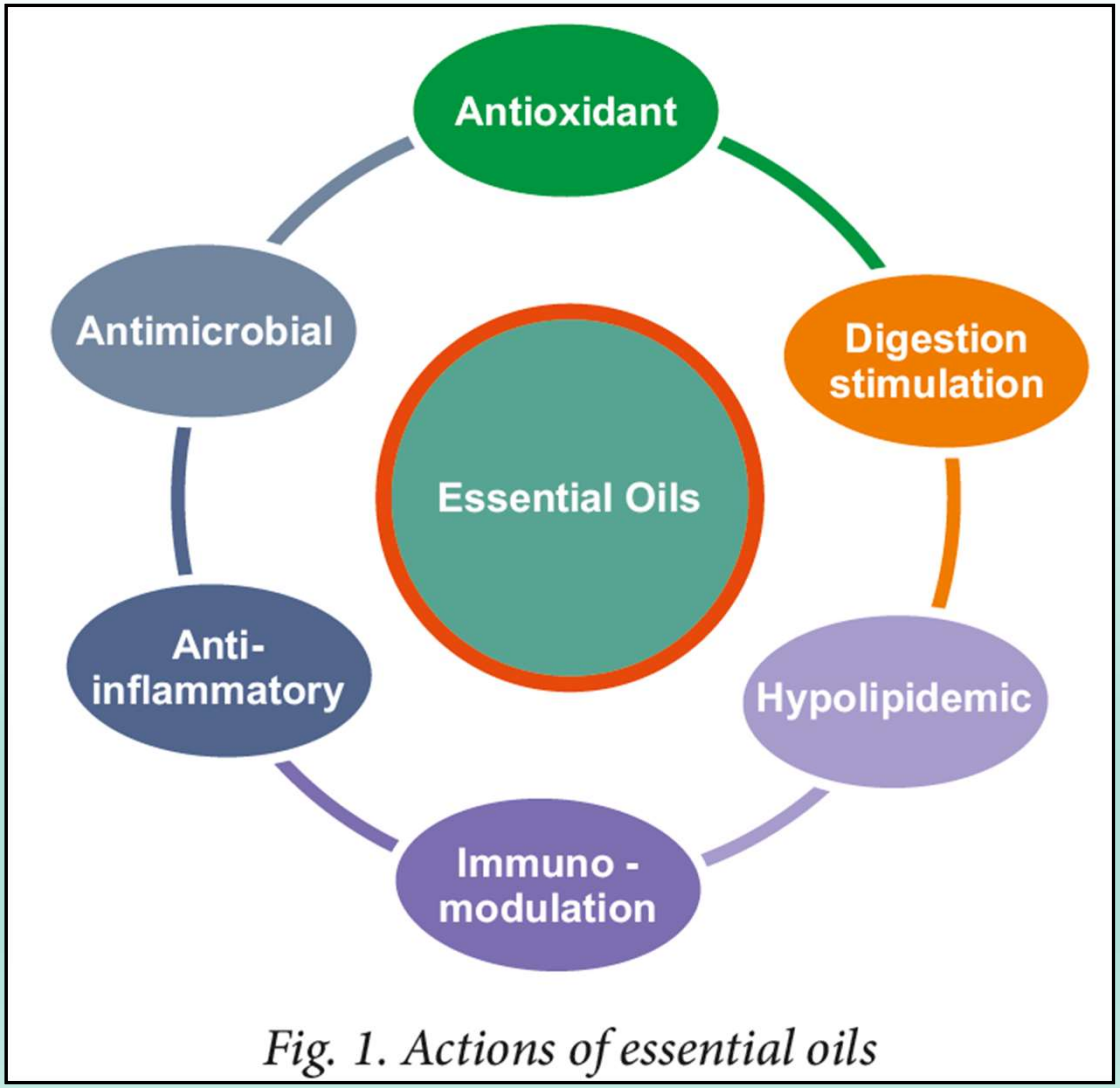


Fig. 1. Actions of essential oils

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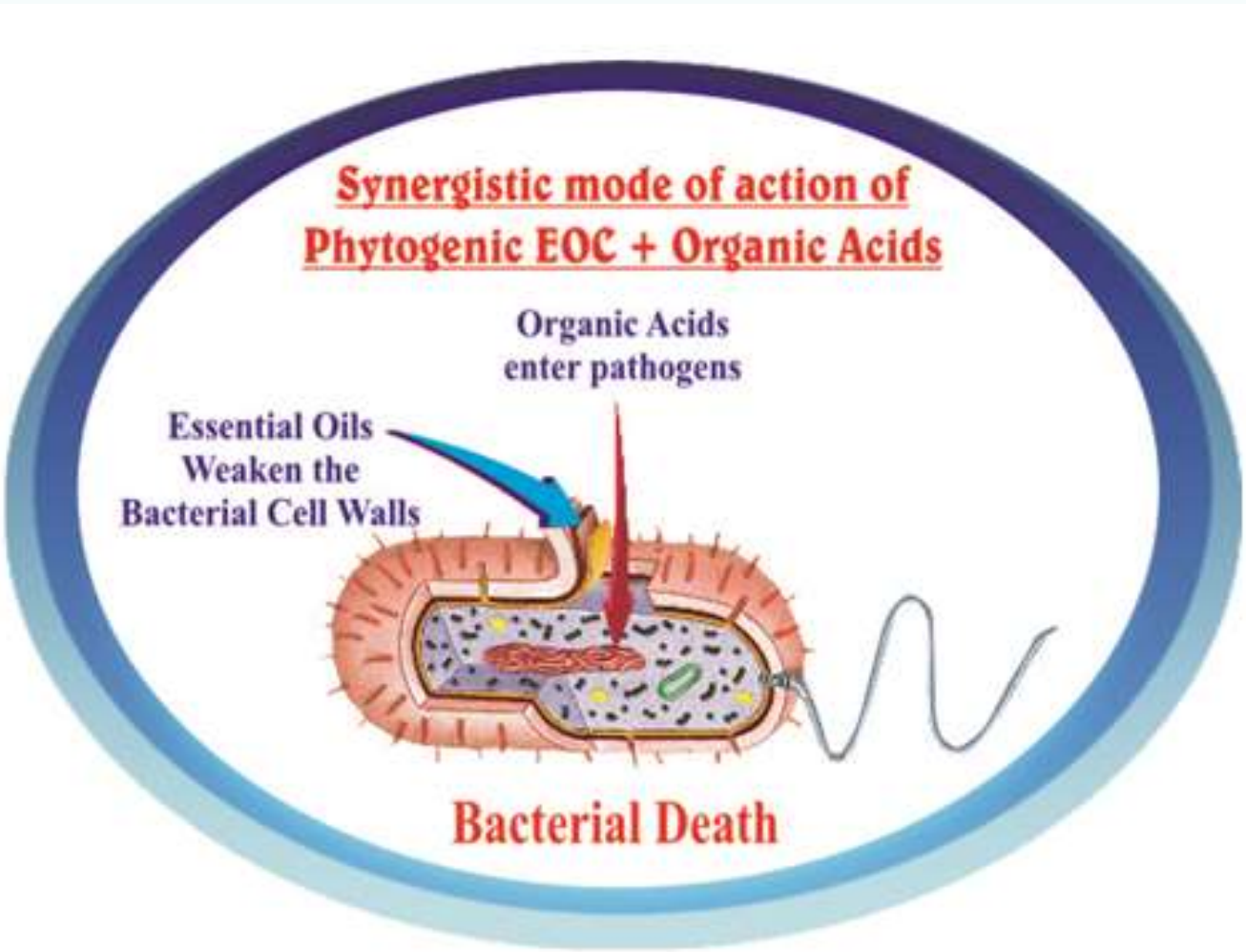
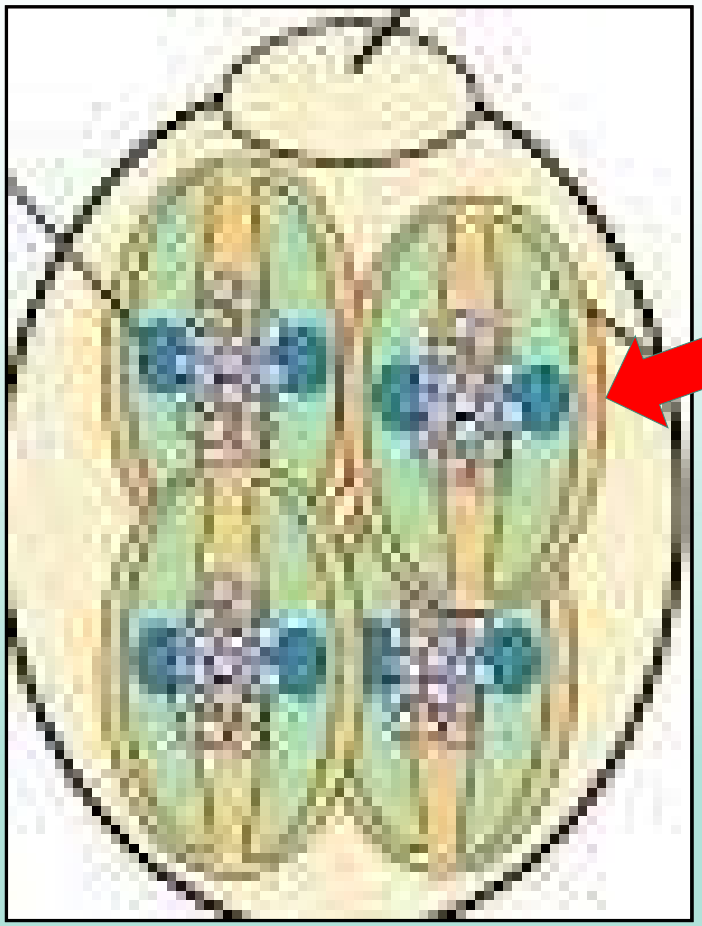


NAGRONEX® ESF

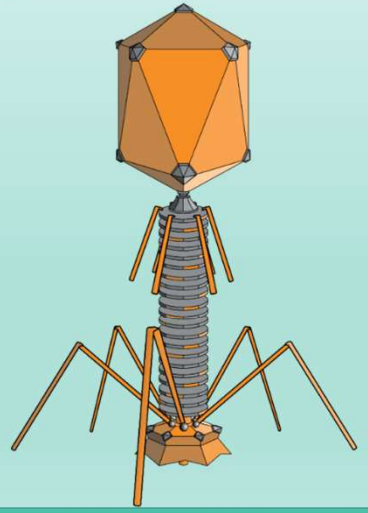


SPORULATED OOCYST

CINEOLE &
CINNAMALDEHYDE

Bacteriophages – What are they ?

- Bacteriophages (phages) are viruses that infect only bacteria
- Most abundant and most genetically diverse organisms on earth
- Highly species specific & considered safe
- Do not infect plant, animal or human cells
- Till date only against *E. Coli*, Salmonella and Clostridium



BACTIPHAGE™-EC

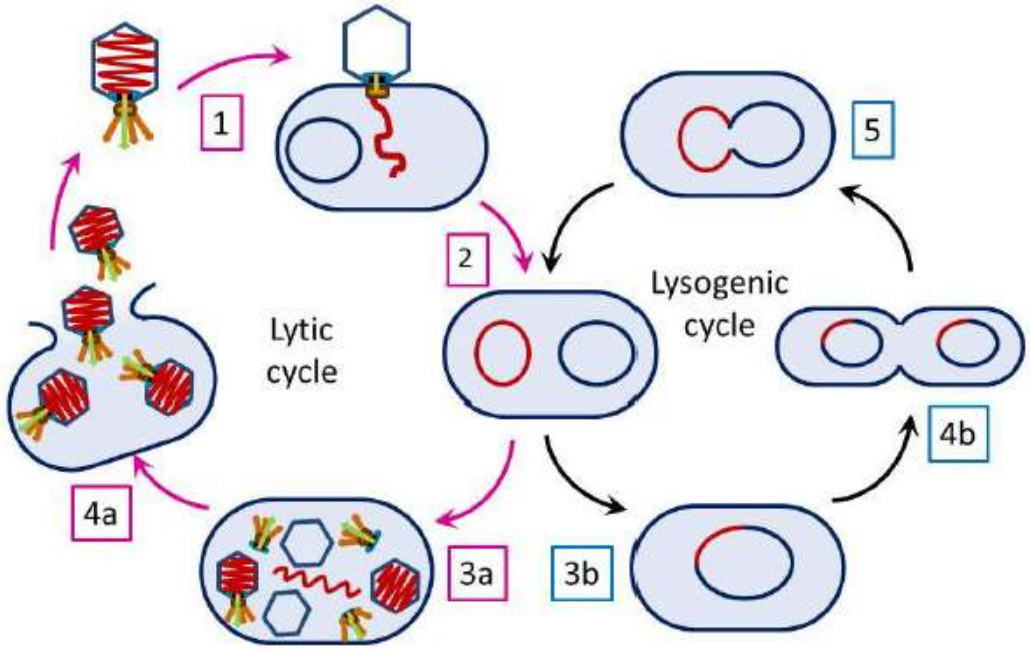


Fig. 1. Two cycles of bacteriophage reproduction. 1 - Phage attaches the host cell and injects DNA; 2 – Phage DNA enters lytic or lysogenic cycle; 3a – New phage DNA and proteins are synthesised and virions are assembled; 4a –Cell lyses releasing virions; 3b and 4b – steps of lysogenic cycle: integration of the phage genome within the bacterial chromosome (becomes prophage) with normal bacterial reproduction; 5- Under certain conditions the prophage excises from the bacterial chromosome and initiates the lytic cycle. (Copyright of E.V. Orlova)

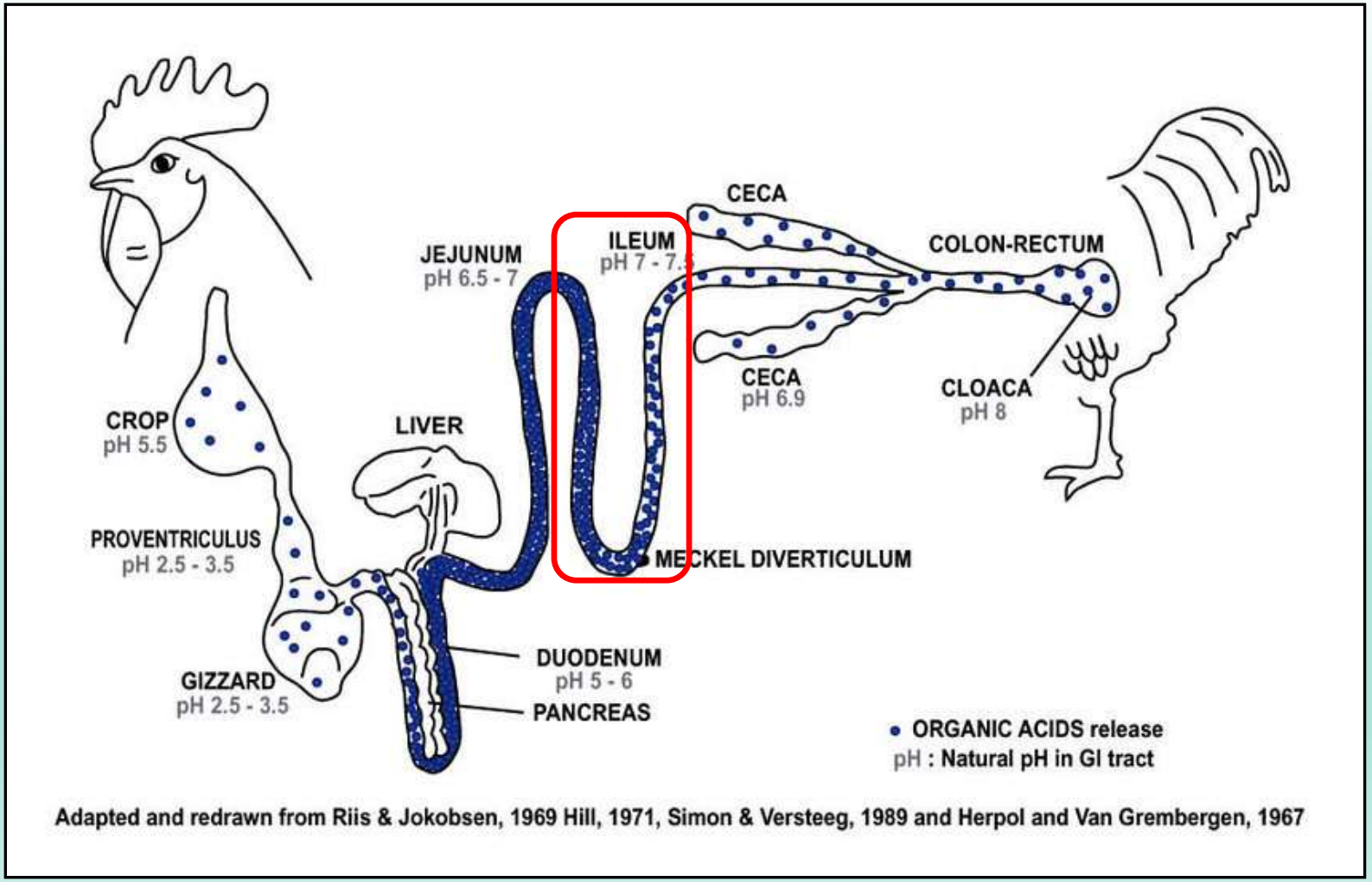
Organic acids

1. Formic
2. Acetic
3. Propionic
4. Butyric
5. Valeric
6. Lactic
7. Benzoic
8. Malic

Salts of organic acids

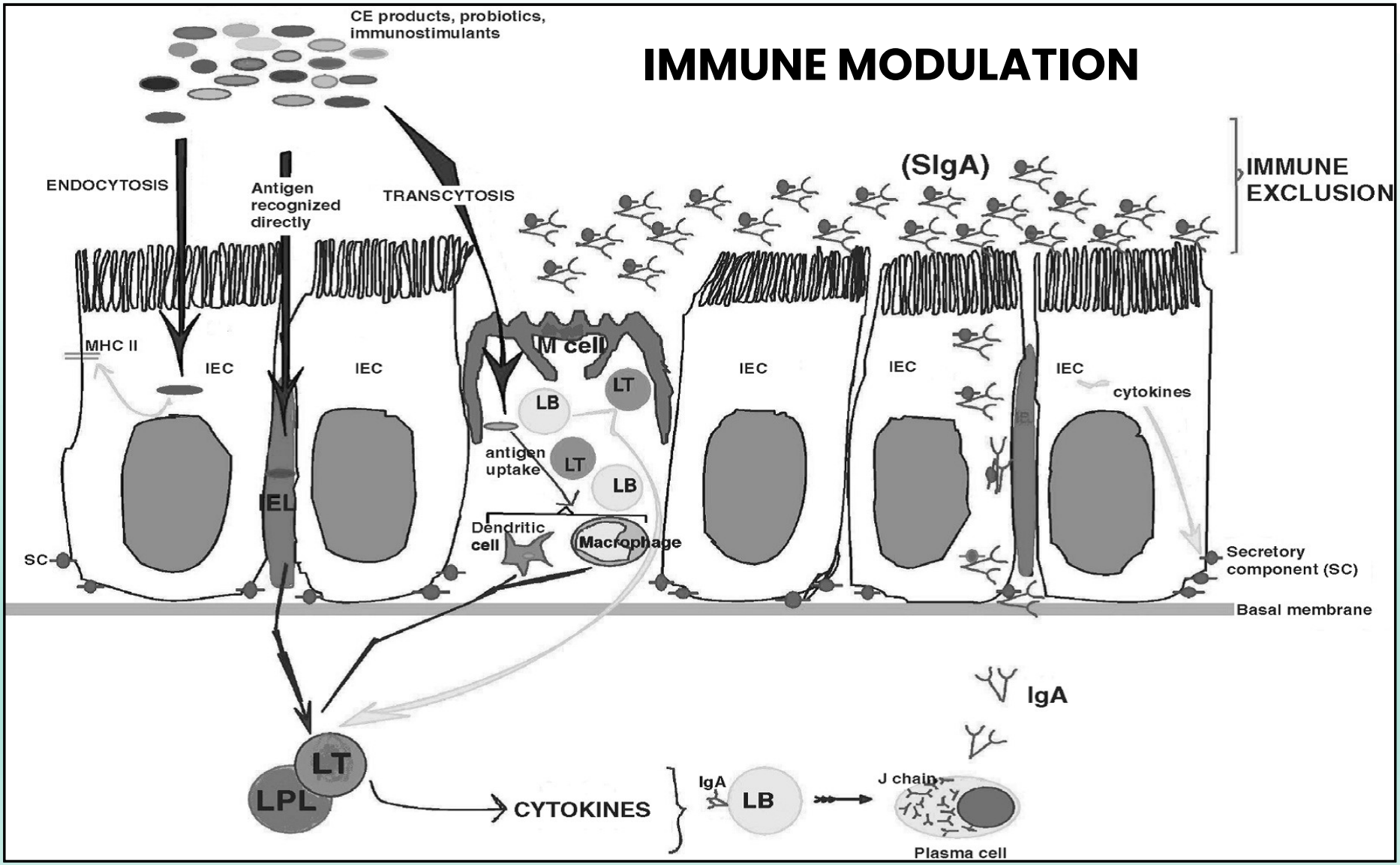
Coated organic acids

Organic acid release in gut



Adapted and redrawn from Riis & Jokobsen, 1969 Hill, 1971, Simon & Versteeg, 1989 and Herpol and Van Grembergen, 1967

IMMUNE MODULATION

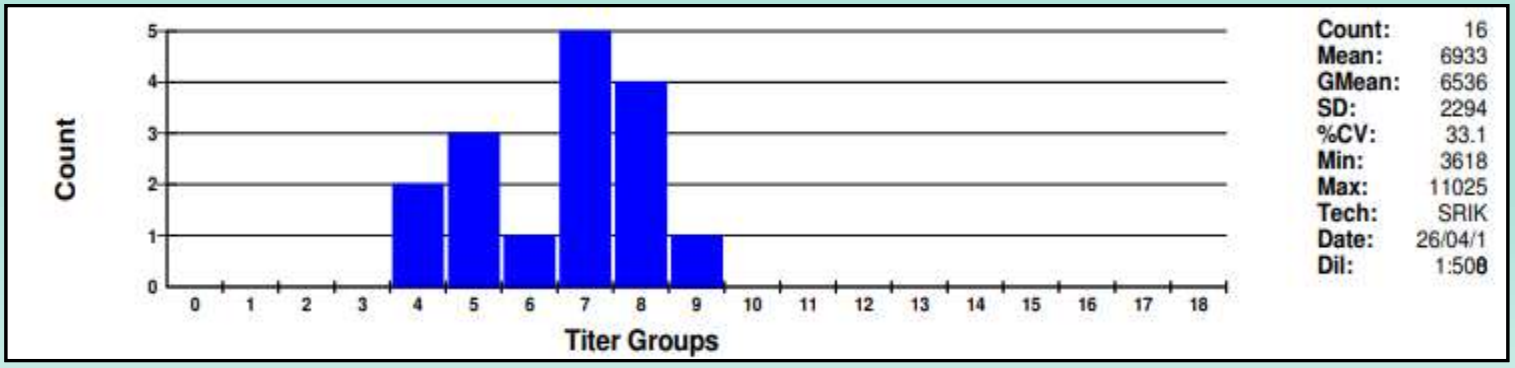


Effect of usage of MOS & β Glucans in feed on seroconversion

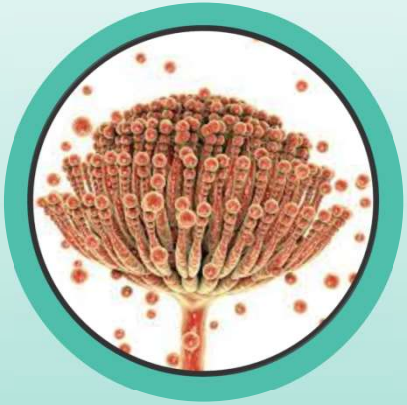
- **The results showed broilers in treatment groups had lower mortality rate and higher antibody titers of Newcastle disease virus (NDV), compared with control group.**

- **The immunological analysis found that spleen and thymus indices were markedly improved, the cytokine concentrations in serum were increased, and the activities of heterophils and lymphocytes were up-regulated when the feed was supplemented with *B Glucans and MOS.***

Ref : https://www.researchgate.net/publication/306282913_



Other tools for improving gut health



Mycotoxin binders and antifungals

Emulsifiers

Vitamins and organic trace minerals

Management tools for improving gut health

Feed and water

Ventilation

Preventive vaccination and medication

Floor, feeding and drinking space

Conclusion

Performance

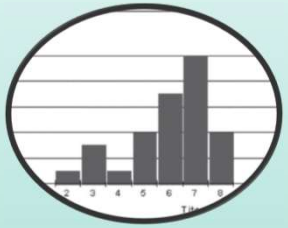
1. Egg production & hatchability
2. FCR
3. Body weight gain

Nutrient utilization

1. Improve digestion
2. Controls loose litter
3. Cleaner eggs
4. Lesser ammonia.

Livability

1. Reduce mortality.
2. Increases disease resistance.



Seroconversion

1. Good seroconversion.
2. Maintains immune status of the birds

Recap


Essential oils
AGPs & Anticoccidials
Synbiotics (Prebiotics and probiotics)
RECAP
Organic Acids
Enzymes
Bacteriophages

THANKS FOR THE ATTENTION