Probiotics and their Derivative Preparations as Nature-Based Solutions for One Health Advancements

Hary Razafindralambo[1,2,*], Vijayaram Srirengaraj[3], Huu-Thanh Nguyen[4], W. H. Coulibaly[5]

[1] Université de Liège & [2]ProBioLab, Namur, Belgium
[3] National Chung Hsing University, Taiwan
[4] An Giang University, Vietnam
[5] University Nangui Abrogoua, Ivory Coast

* **Corresponding author**:[1] h.razafindralambo@uliege.be; [2] probiolab@europe.com

MENU

PURPOSE

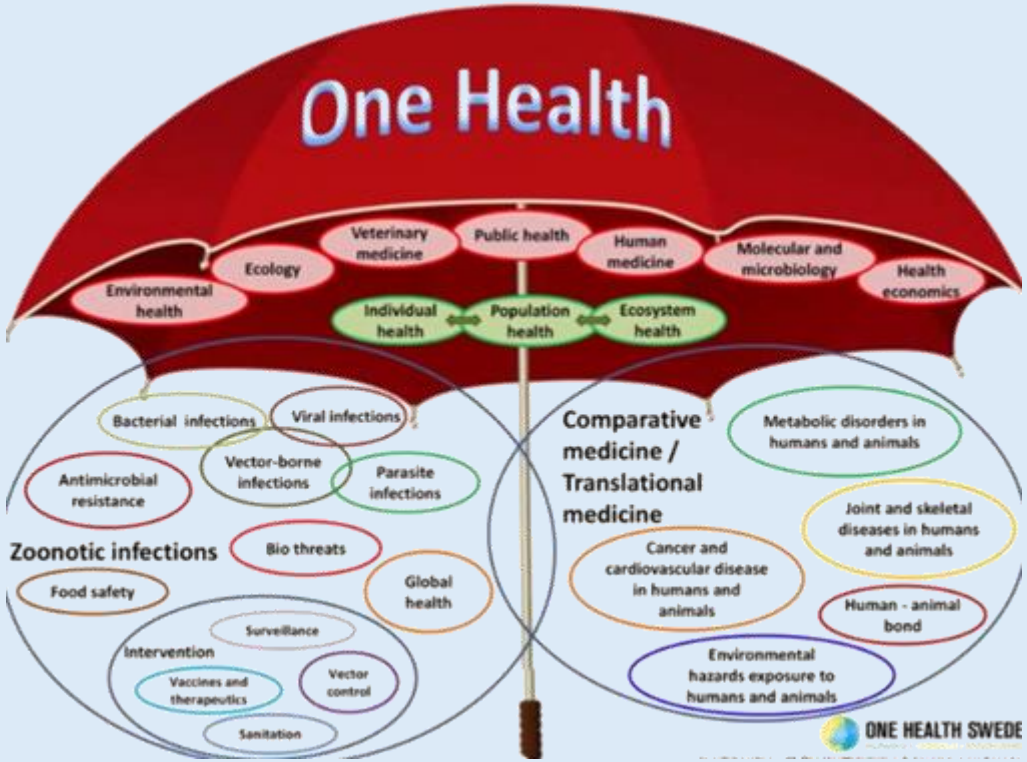
An overview and discussion of relevant functionalities and applications of **probiotics and their derivative products** as nature-based solutions for **One Health advancements** through various relevant examples.

OUTLINE

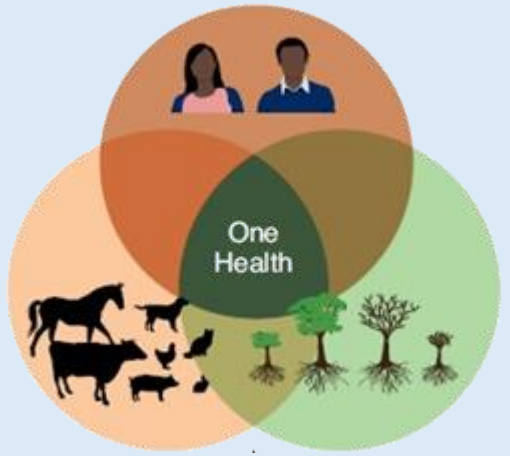
1. « One Health » Concept
2. Biotic species
3. Illustrations in animal health
4. Concluding remarks

One Health Concept

One Health is an interdisciplinary and multisector approach that recognizes the human, animal, and environmental health relationships, requiring a collaborative effort at the local, national, and global levels.



Example in Africa



Promote interdisciplinary **surveillance** & **response**

Human health
- Manage urbanization
- Reduce human conflict
- Regulate antimicrobial use and prescription
- Address socioeconomic inequities
- Expand research into emerging diseases

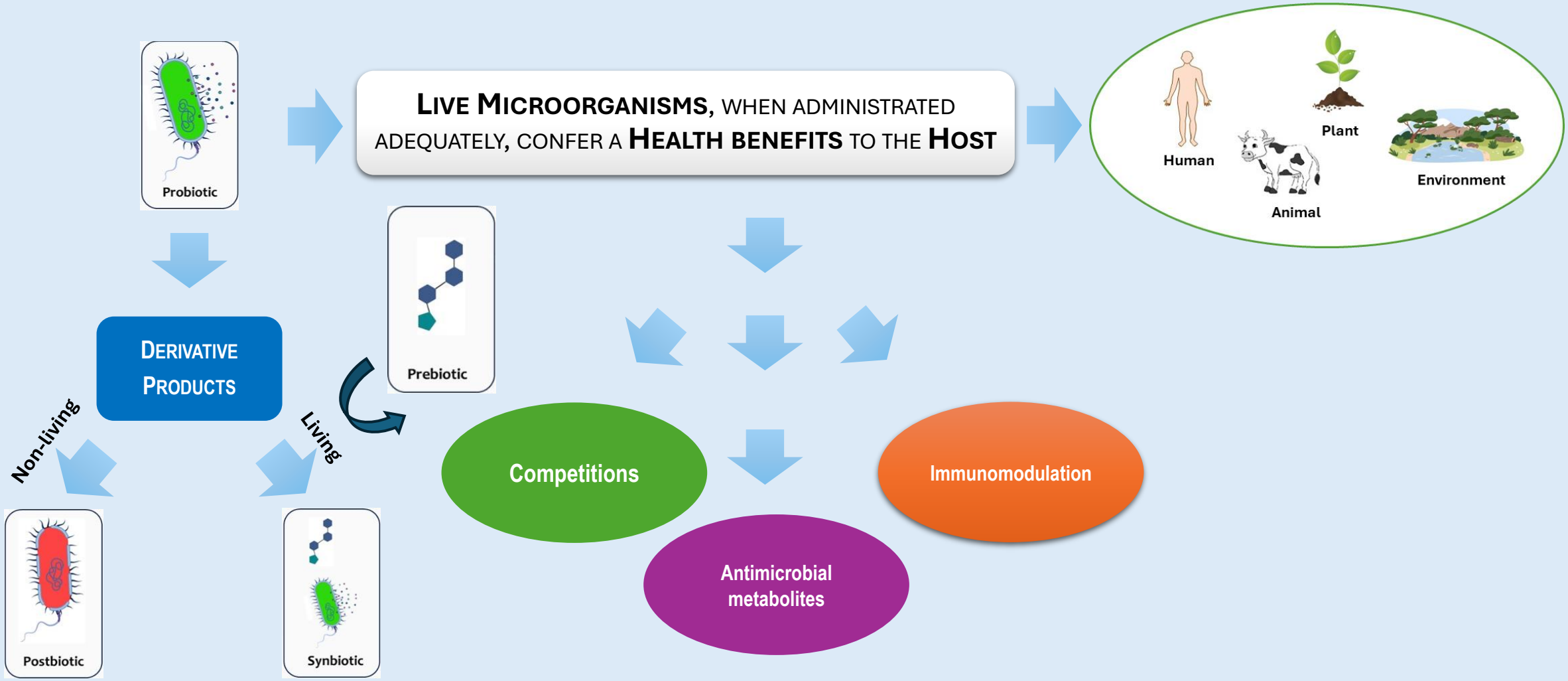
Animal health
- Promote improved farming practices
- Regulate use of wildlife
- Regulate antimicrobial use and prescription
- Regulate food supply chains and processing
- Expand research into emerging diseases

Environmental health
- Reduce deforestation and promote conservation
- Limit environmental pollution
- Improve housing
- Improve waste management
- Expand research into climate change

- Greater biodiversity in the ecosystem and sustainability of natural resources
- Reduced disease outbreaks in humans and animals
- Reduced socioeconomic inequalities
- Improved food security
- Improved global health security

Otu A., Effa E., Meseko C., ..., Ebenso B. ***Nature Medicine*, 2021**, 27:940

Biotic species for a « One Health » approach

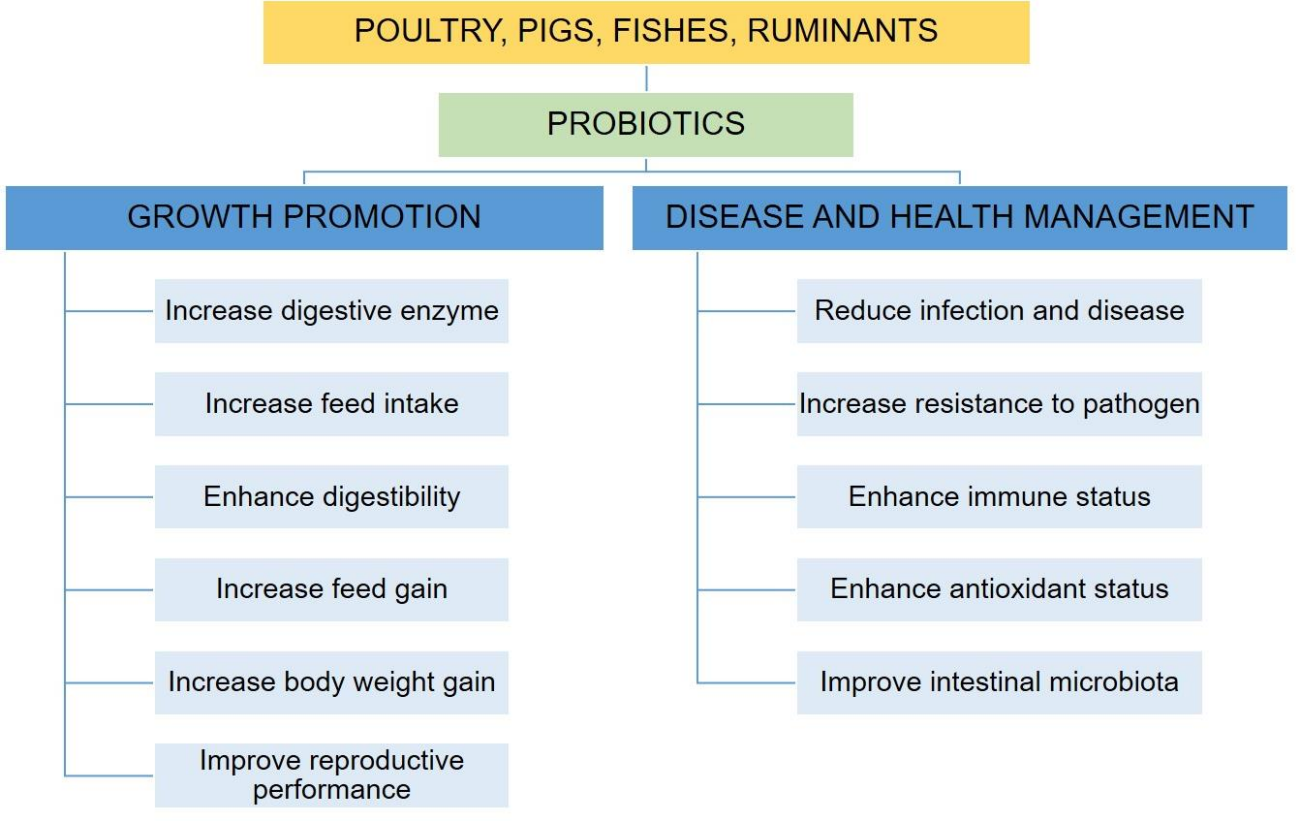


Lactobacilli species as One Health probiotic candidates

Probiotic	Human	Animal	Plant (Tomato) Products	Plant	Soil
Lactiplantibacillus plantarum	Food-associated *Lpb. plantarum* shows a good adaptation and adhesion ability in the gastrointestinal tract and the potential to affect host health through various beneficial activities [118].	*Lpb. plantarum* supplementation can modulate overall health and immunity [119] as well as gut microbial composition and the interaction network between gut microbiota and the immune system [120].The anti-*Helicobacter pylori* effects of the probiotic in the stomach tissue of C57BL/6 mice has also been described [89].	The use of this probiotic in the creation of fermented tomato juice products might be quite effective [113,114]. *Lpb. plantarum* is the main bacterial species associated with olive processing [121]. Probiotic tomato juice could serve as a health beverage for vegetarians/consumers who are allergic to dairy products [122].	This probiotic has been frequently found in environments associated with plants [123–125]. Significant stimulation of germination in tomatoes with poor initial germination capacity was achieved by soaking their seeds for 6 h in suspensions of nine out of ten *Lpb. plantarum* strains tested [126].	This probiotic has highly antagonistic activities against most soil pathogens [37].

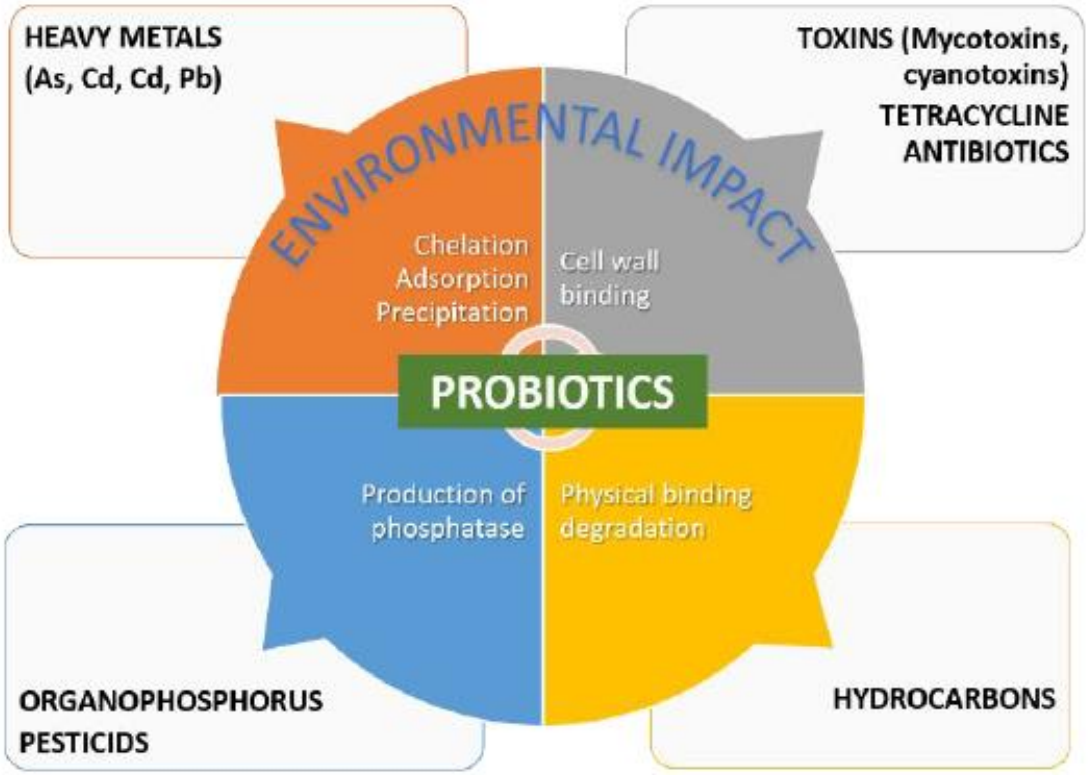
Harutyunyan, N.; Kushugulova, A.; Hovhannisyan, N.; Pepoyan, A. ***Plants* 2022**, 11, 1334.

Animal growth & health



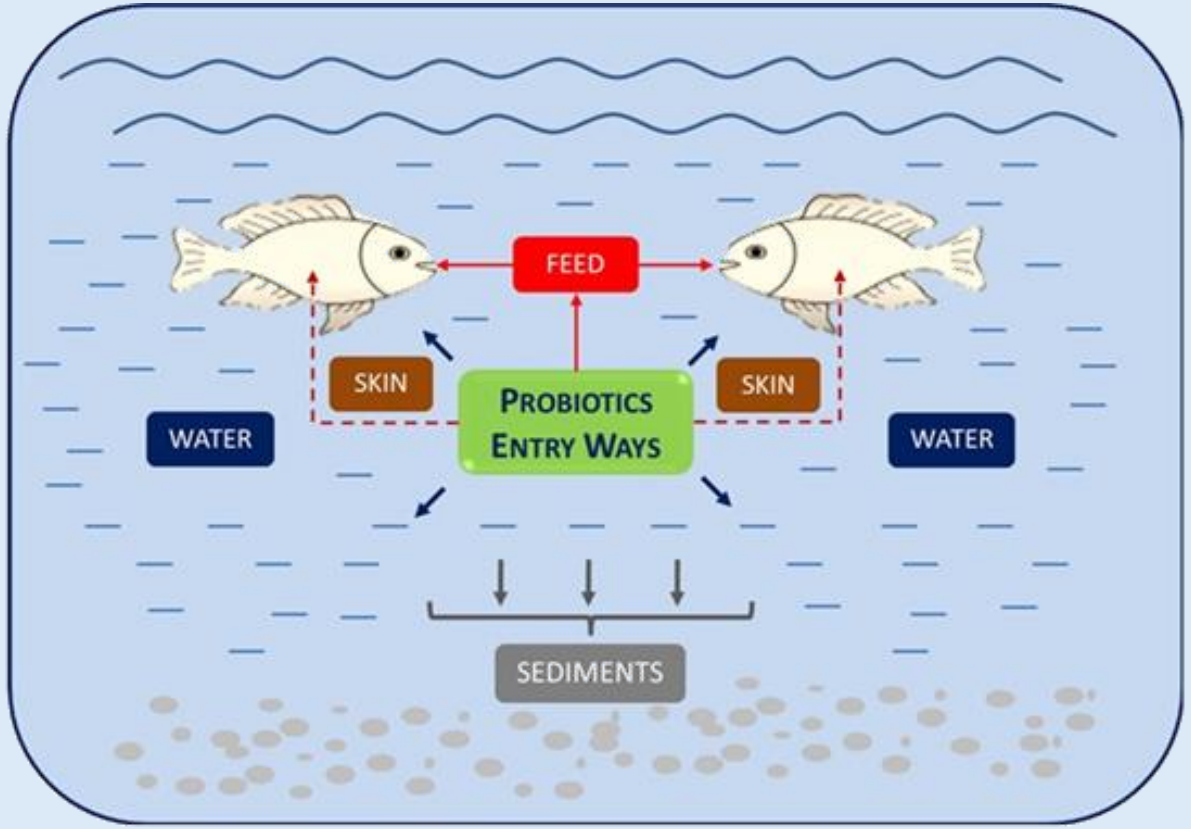
Rabetafika, H.N.; Razafindralambo, A.; Ebenso, B.; Razafindralambo, H.L. Probiotics as Antibiotic Alternatives for Human and Animal Applications. ***Encyclopedia*** **2023**, 3, 561–581.

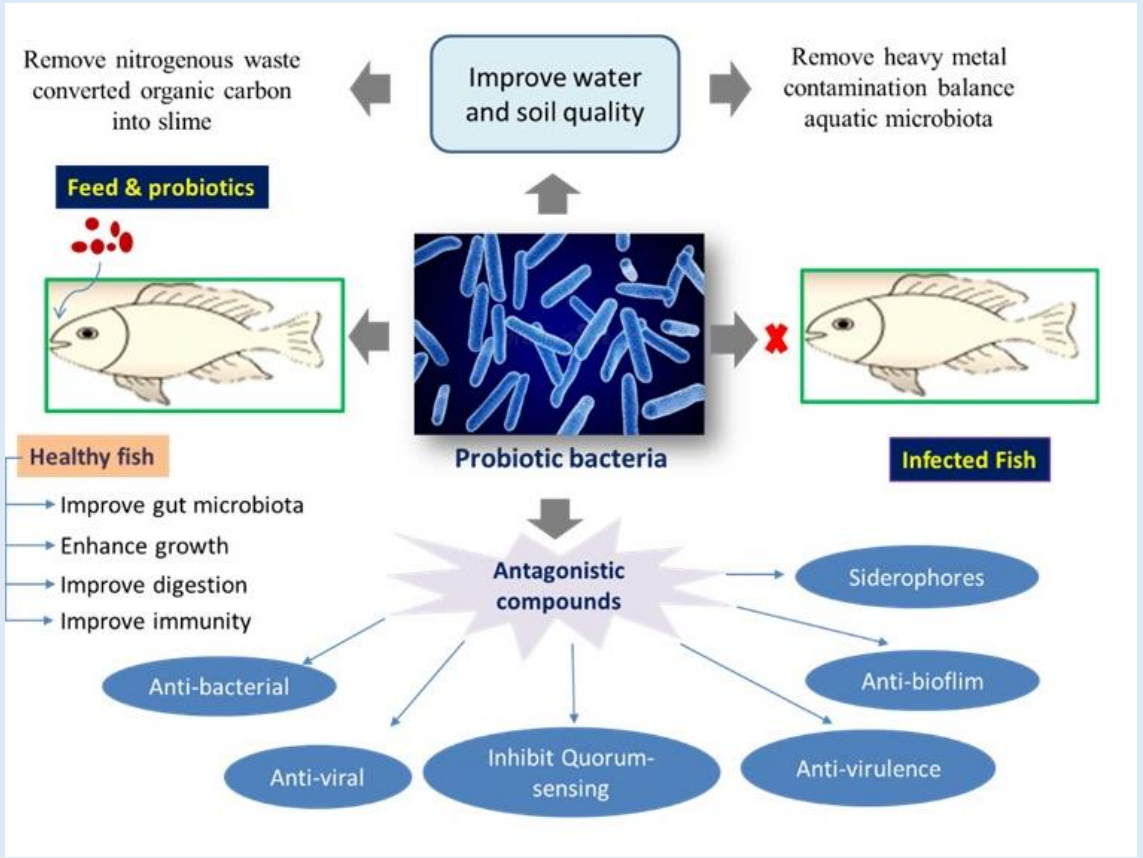
Bioremediation



Kouhounde, S.; Adeoti, K.; Mounir, M.; Giusti, A.; Refinetti, P.; Otu, A.; Effa, E.; Ebenso, B.;...and Razafindralambo, H. Applications of Probiotic-Based Multi-Components to Human, Animal and Ecosystem Health: Concepts, Methodologies, and Action Mechanisms. ***Microorganisms*** **2022**, 10, 1700.

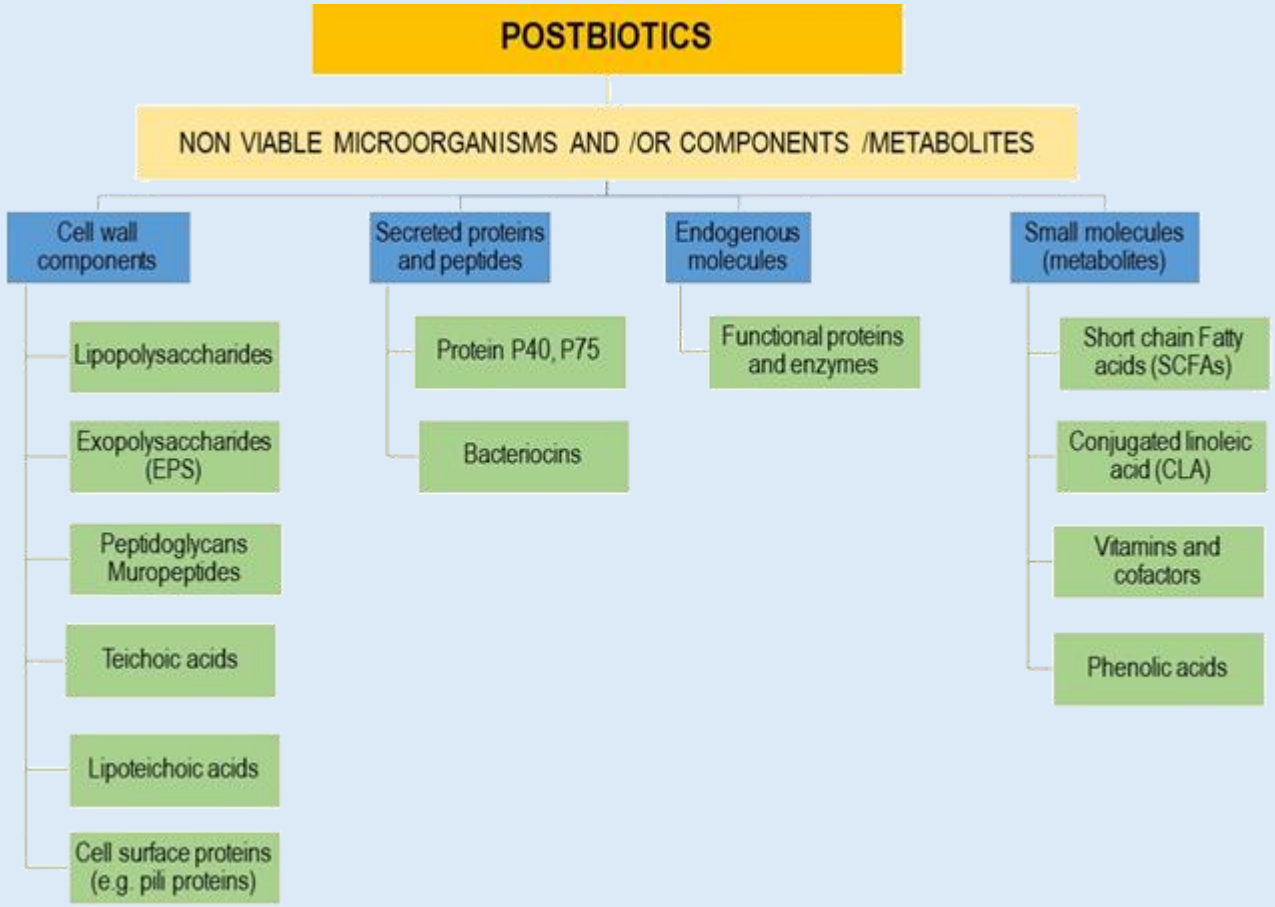
Fish health & water quality

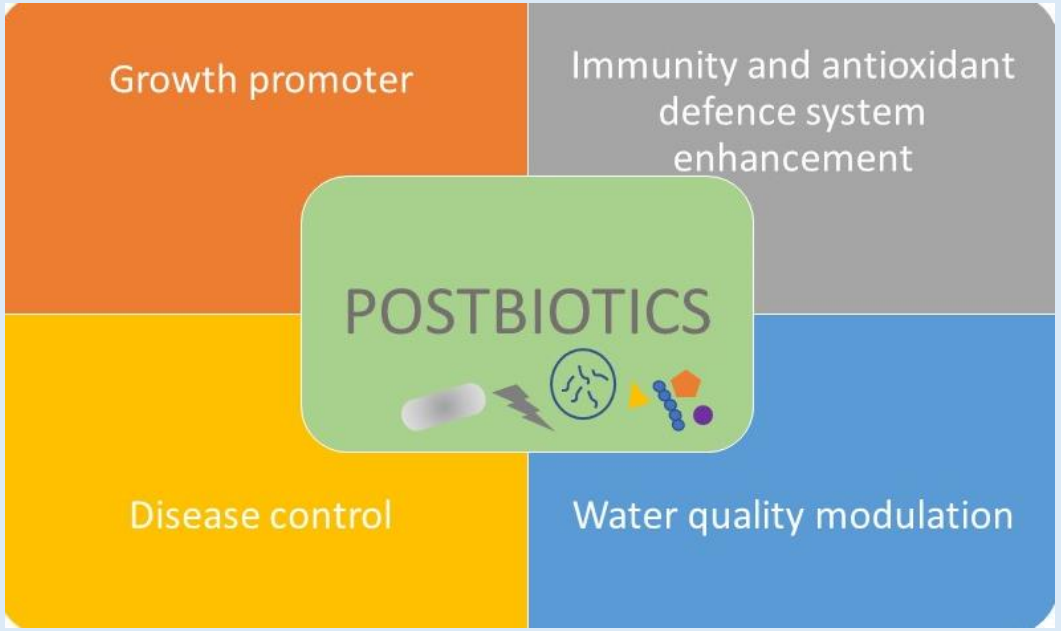




Srirengaraj, V.; Razafindralambo, H.L.; Rabetafika, H.N.; Nguyen, H.-T.; Sun, Y.-Z. Synbiotic Agents and Their Active Components for Sustainable Aquaculture: Concepts, Action Mechanisms, and Applications. ***Biology* 2023**, 12, 1498

Postbiotics and their functionalities

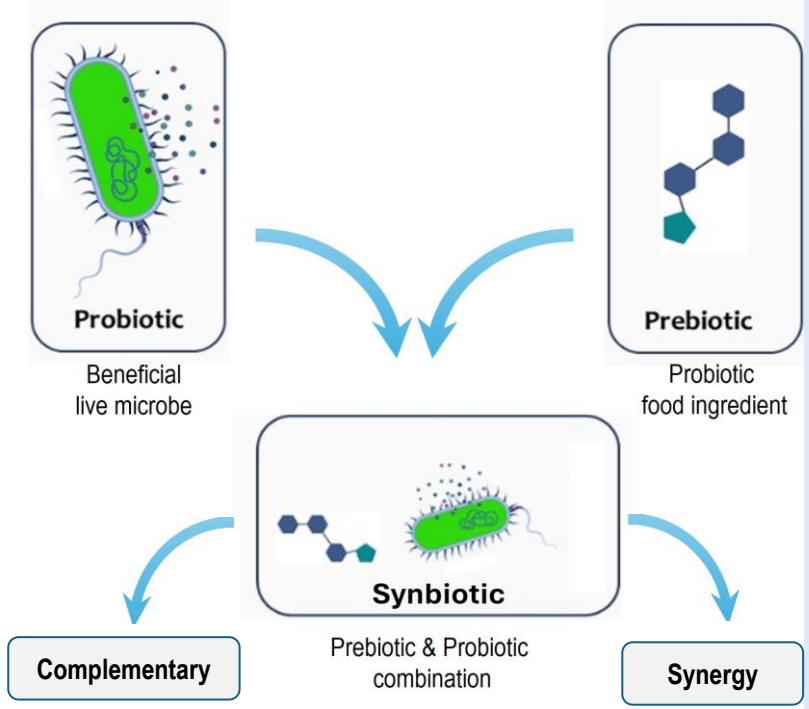




Srirengaraj, V.; Razafindralambo, H.L.; Rabetafika, H.N.; Nguyen, H.-T.; Sun, Y.-Z. Synbiotic Agents and Their Active Components for Sustainable Aquaculture: Concepts, Action Mechanisms, and Applications. ***Biology* 2023**, 12, 1498

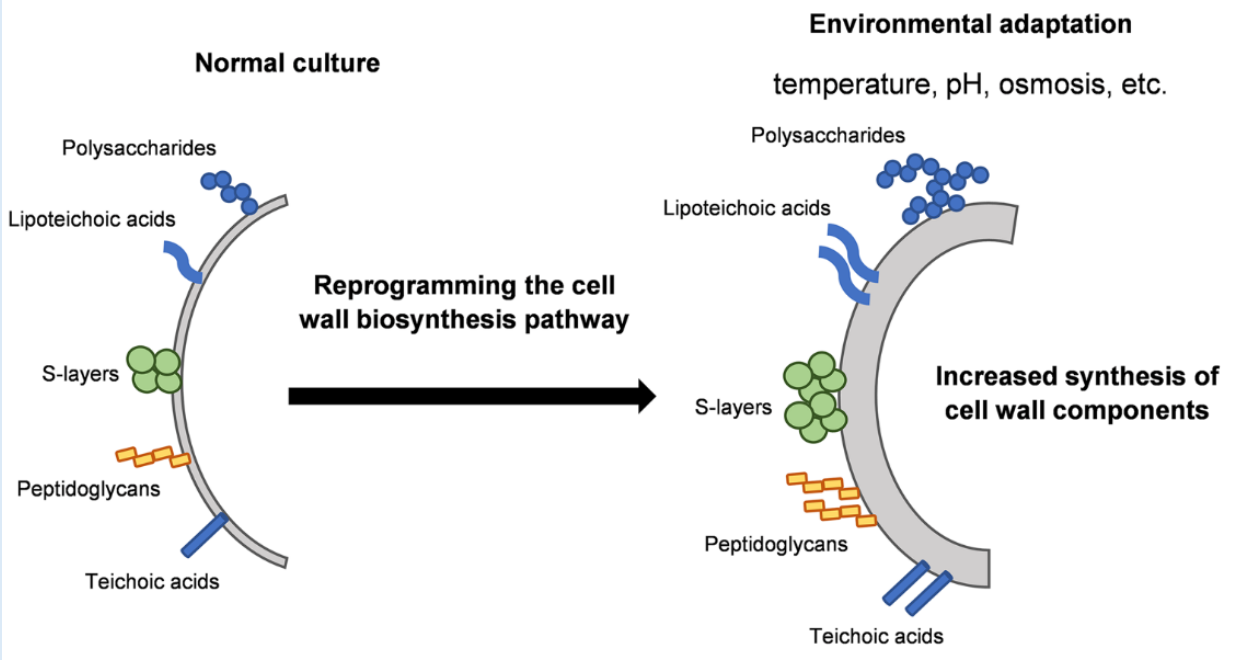
Synbiotics & preparation modes

Mixing Probiotic with Prebiotics



Swanson et al. *Nature Reviews Gastroenterology & Hepatology*. **2020**, *17*:687–701

Probiotic autoproduction



Nguyen, T.-T.; Nguyen, P.-T.; Pham, M.-N.; Razafindralambo, H.; Hoang, Q.-K.; Nguyen, H.-T. Synbiotics : A New Route of Self-Production and Applications to Human and Animal Health. Probiotics & Antimicrobial Proteins **2022**, *14(5):*, 980-993.

Examples of synbiotic effect on animal health

Animals	Synbiotics	Effects
Poultry	*S. cerevisiae* + MOS	Increased weight gain, reduced *E. coli* numbers in the small intestine and cecal digesta.
	B. subtilis + FOS	Improved average daily growth, FCR, reduced incidence of diarrhea and mortality.
Pig	*Enterococcus faecium*, *L. salivarius, L. reuteri, Bifidobacterium thermophilum* + INULIN	Decreased relative abundance of *Escherichia* in the ileum, cecum, and colon, and increased bifidobacterial numbers in the ileum.
	L. plantarum + MALTODEXTRIN and/or FOS	Reduced counts of *E. coli* O8:K88 in the jejunum and colon of piglets, and increased acetate concentrations in the ileum and colon.
Ruminants	*Enterococcus faecium* + LACTULOSE	Decreased the ileal villus height, the depth of the crypts in the cecum, and the surface area of lymph follicles from Peyer's patches.
	S. cerevisiae + INULIN	Increased pH in rumen, abomasum, and intestines, positively impacted the development of almost all morphological structures of rumen saccus dorsalis, rumen saccus ventralis, and intestine.
Aquatic animals	*B. subtilis* WB60 + MOS	Improved growth performance, nonspecific immune responses and disease resistance in Japanese eel.
	Pediococcus acidilactici + EPSi	Enhanced skin mucus and blood immune responses, upregulated immune-related genes expression, increased intestinal SCFAs content as well as promoted antioxidative capacity.

Mounir, M., Ibijbijen, A., Farih, K., Rabetafika, H.N. and Razafindralambo, H.L., 2022. Synbiotics and their antioxidant properties, mechanisms, and benefits for human and animal health: A narrative review. ***Biomolecules***, 12(10), p.1443.

Conclusion

1. **Probiotics** and their derivative products such as **postbiotics** and **synbiotics** are natural and universal potential **candidates** for a **One Health approach** to reach **optimal health** among **people**, **animals** and our **environment**.

2. Their efficient and successful use needs **multidisciplinary** and **worldwide actions**, which should involve scientists (microbiologists, physicists, chemists, medical experts, veterinarians, biologists, etc.), technologists, industrials, regulators, farmers, and so on.

3. An efficacious **combination of living and non-living biotic species** is among the promising **One Health strategy** for tackling the disruption of human, animal, and environmental health at the origin of emerging infectious diseases and epidemics worldwide.

Collaborators

Dr. Hary Razafindralambo
✉: h.razafindralambo@uliege.be

Dr. Srirengaraj Vijayaram
✉: vijayarambiotech@gmail.com

Dr. Huu-Thanh Nguyen
✉: nhthanh@agu.edu.vn
An Giang University
Vietnam

Dr. Hermann W. Coulibaly
✉ : wahauwouele@yahoo.fr
University Nangui
Abrogoua, Côte d'Ivoire

Acknowlegments

https://urbane-project.eu/wp-urbane/

Thank you for your attention