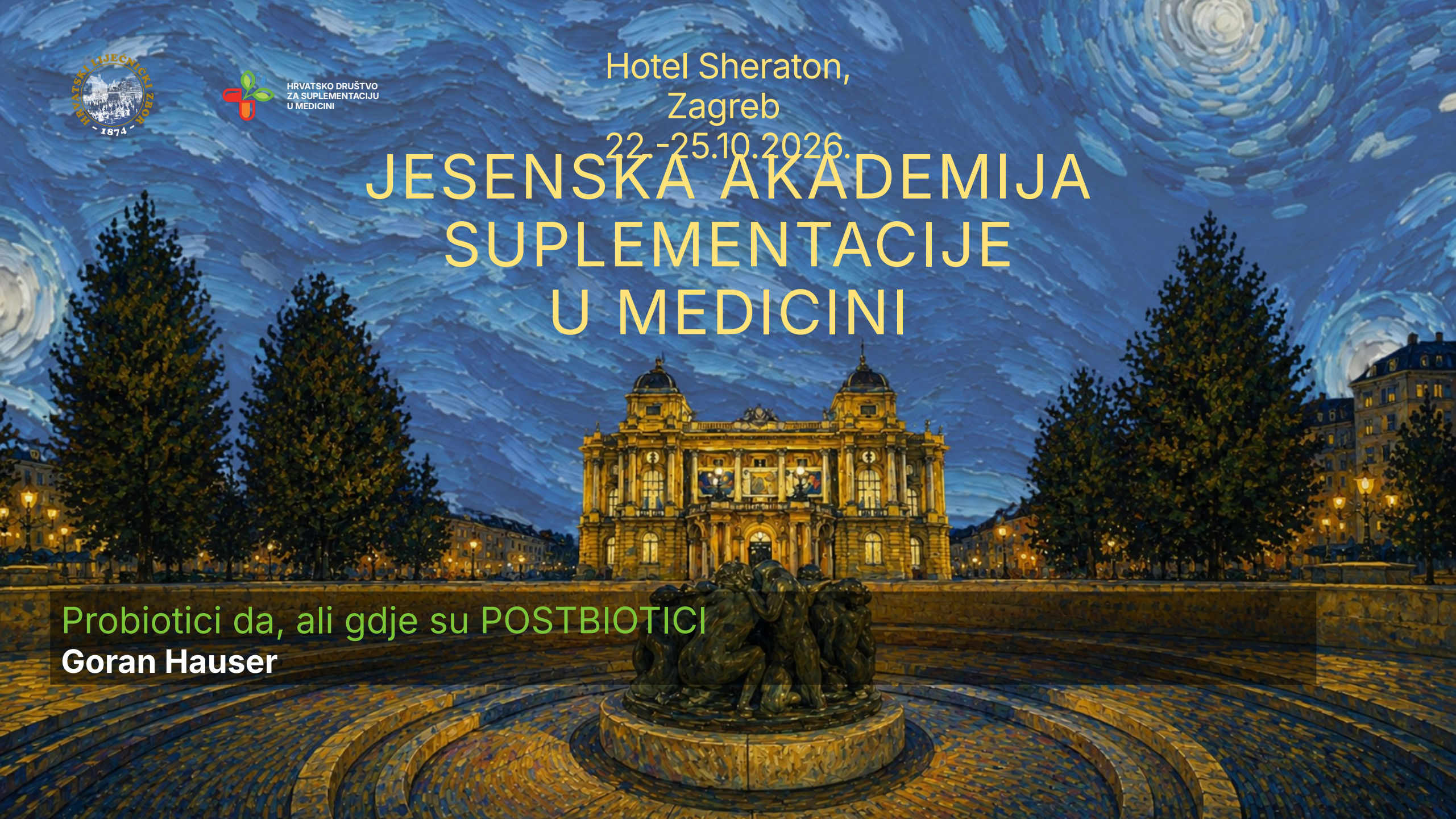

HRVATSKO DRUŠTVO
ZA SUPLEMENTACIJU
U MEDICINI
Hotel Sheraton,
Zagreb
22.-25.10.2026.
JESENSKA AKADEMIJA
SUPLEMENTACIJE
U MEDICINI
Probiotici da, ali gdje su POSTBIOTICI
Goran Hauser

Svijet -biotika

Probiotik, prebiotik, sinbiotik, postbiotik i kratki podsjetnik o mikrobioti

1

2

NOVOST 1

Postbiotici

Što su, kako nastaju (tindalizacija) i od čega se sastoje

Mehanizmi djelovanja

Imunomodulacija, crijevna barijera, potpora mikrobiomu

3

4

Klinička primjena 3P

Područja primjene i primjer soja *L. rhamnosus* CRL1505

NOVOST 2

K. marxianus

Je li *S. boulardii* dobio konkurenciju?

5

6

Era tribiotika

Zaustaviti proljev, rekolonizirati, pomoći imunitetu

CENTAR ZA DIGESTIVNU I METABOLIČKU MEDICINU

STOOL BIOBANK

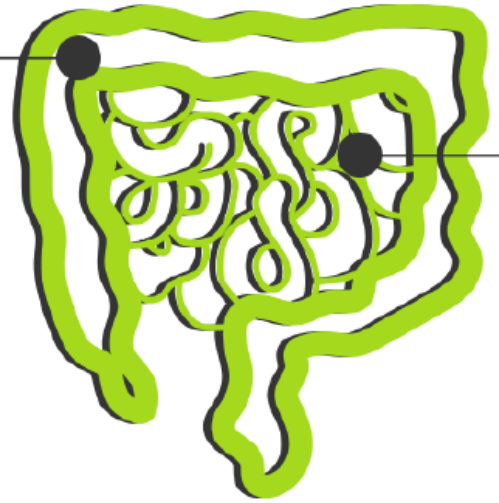
KBCri MEDri UNIri

Kratki podsjetnik

Microbial colonization of the gut

Large Intestine
10^9 έως 10^{12} CFU/g Faeces

10^9-10^{12} Bifidobacterium
10^9-10^{12} Bacteroides
10^9-10^{12} Eubacteria
10^3-10^8 Fusobacteria
10^3-10^7 Veillonella
10^3-10^6 Clostridia
10^5-10^9 Enterobacteriaceae
10^5-10^9 Enterococcus
10^3-10^9 Lactobacillus
10^3-10^7 Staphylococcus
10^2-10^5 Fungi



Small Intestine
10^5 έως 10^7 CFU/g of chyme

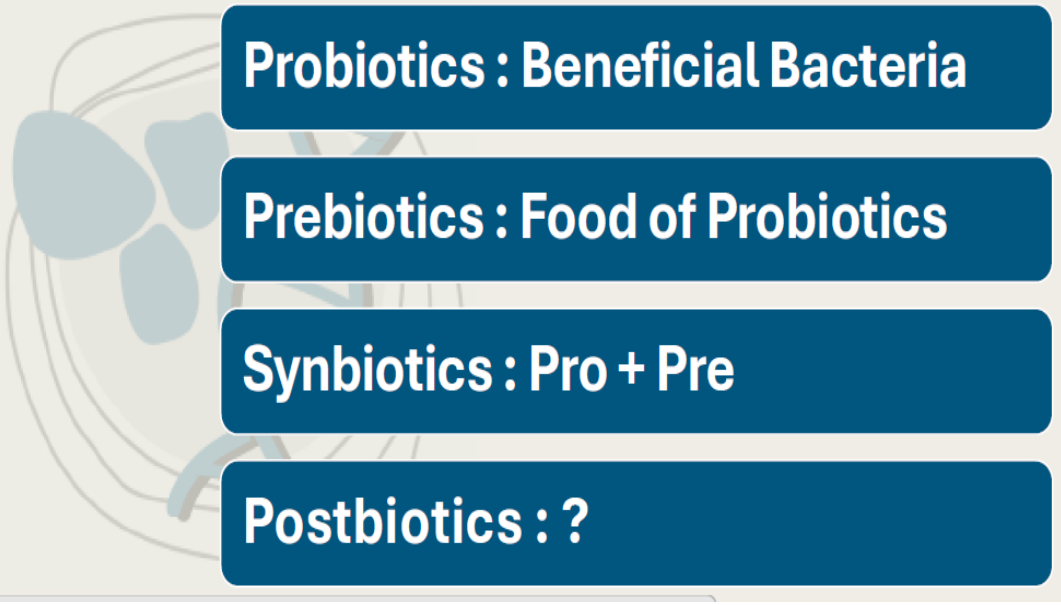
10^4-10^7 Bacteroides
10^3-10^5 Bifidobacterium
10^3-10^6 Lactobacillus
10^3-10^6 Enterococcus
10^3-10^6 Clostridia
10^3-10^6 Enterobacteriaceae
10^3-10^6 Fungi

Svijet -biotika

NOVOST BROJ 1

Svijet -biotika

While Probiotics & Prebiotics are well-defined, the new term of "Postbiotics" has been established in innovative microbiome therapeutics .



Četiri pojma, jedan zajednički zahtjev

Zdravstvena korist pripada definiciji svakog „biotika”.

PROBIOTIK

Živi mikroorganizmi koji u odgovarajućoj količini donose zdravstvenu korist domaćinu

PREBIOTIK

Supstrat koji mikroorganizmi domaćina selektivno iskorištavaju i koji donosi zdravstvenu korist

SINBIOTIK

Mješavina živih mikroorganizama i selektivno iskorištavanog supstrata koja donosi zdravstvenu korist

POSTBIOTIK

Pripravak neživih mikroorganizama i/ili njihovih komponenti s dokazanom zdravstvenom koristi

Mikrobni metabolit nije automatski postbiotik

Hill 2014; Gibson 2017; Swanson 2020; Salminen 2021.

PREBIOTICI • PROBIOTICI • POSTBIOTICI

Kako zajedno djeluju za zdravlje crijeva

PREBIOTICI

Hrana za korisne bakterije

Primjeri:

- Češnjak
- Luk
- Banana
- Zob
- Šparoge
- Cjelovite žitarice



Hrane korisne bakterije

PROBIOTICI

Žive korisne bakterije



Primjeri:



Jogurt | Kefir | Kimchi | Dodaci prehrani

POSTBIOTICI

Povoljni učinci koje stvaraju bakterije

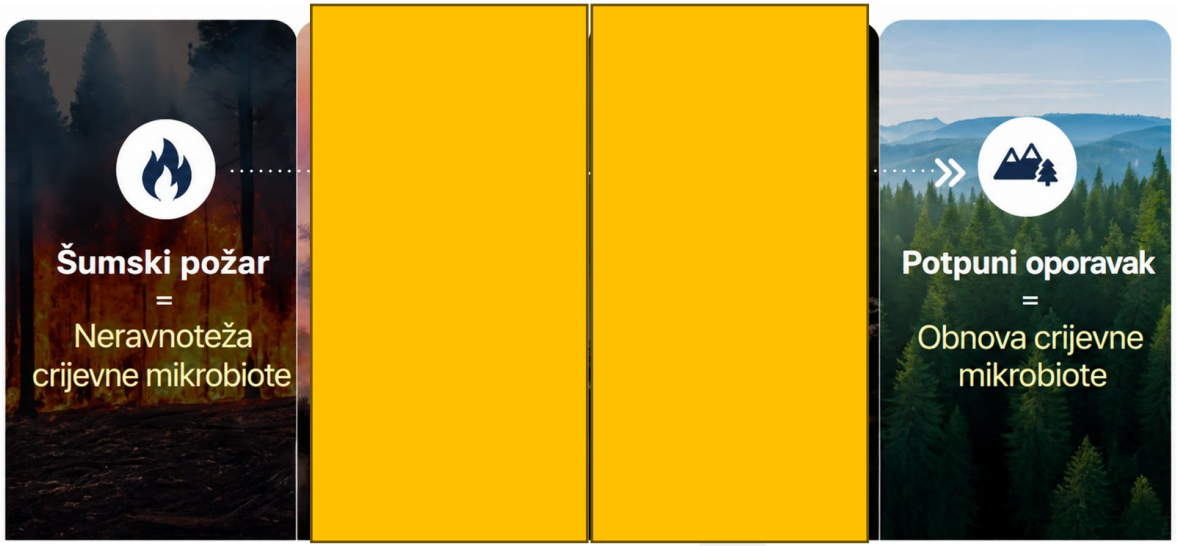
- Bolja probava
- Snažnija imunost
- Smanjena upala
- Bolja crijevna ravnoteža

Podupiru vaše zdravlje

Prebiotici hrane. → Probiotici žive. → Postbiotici štite.

Novost broj 1: prošireni koncept

3P
robiotics
rebiotics
ostbiotics



Postbiotici

relativno noviji koncept u području istraživanja crijevnog mikrobioma

Definicija: Pripravak neživih mikroorganizama i/ili njihovih sastojaka
koji domaćinu donosi zdravstvenu korist

Čak i kada bakterije nisu žive, njihove strukturalne komponente ostaju
biološki aktivne!

Što su postbiotici?

According to ISAPP, postbiotics are defined as a preparation of inanimate microorganisms and/or their components that confers a health benefit on the host. Secreted by-products and cell structures, such as the cell wall, serve beneficial elements; thus taking advantage of both cell structures and excreted bacterial factors.

- **The microbial cells are intentionally inactivated.**
- **The preparation needs to offer a specific health advantage that is scientifically proven to help the body.**

Click here for:
The definition of the term "postbiotics", according to the ISAPP (International Scientific Association for Probiotics and Prebiotics).

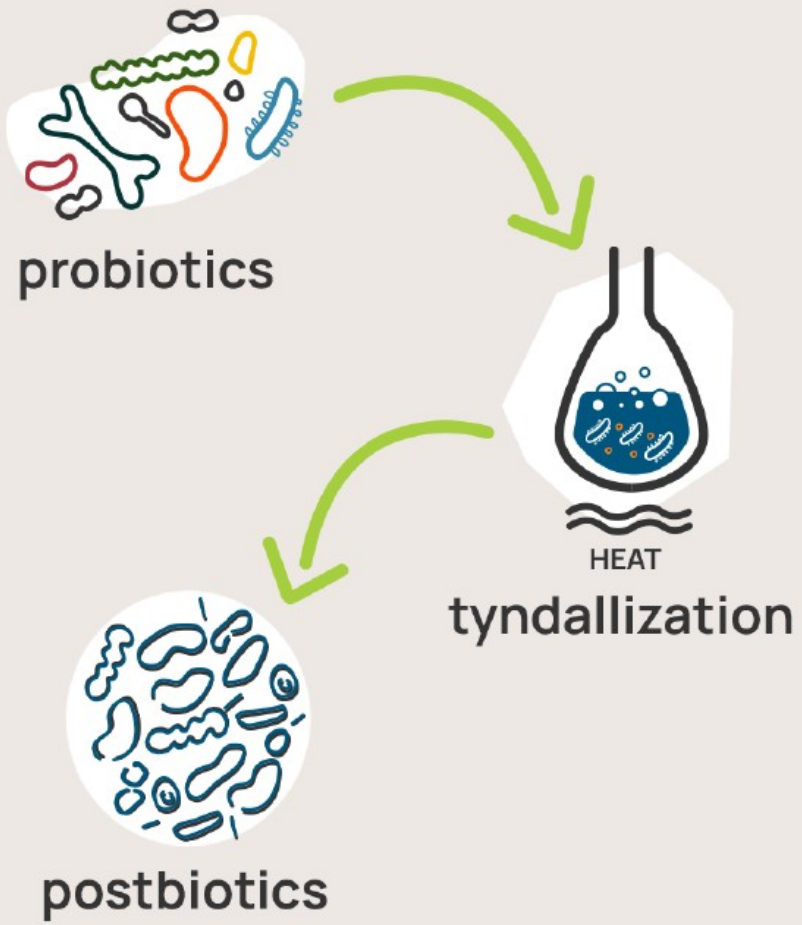
Kako nastaju postbiotic

- Tindalizacija - učinkovita metoda za inaktivaciju probiotika.
  - Probiotici (žive bakterije) izlažu se blagim ciklusima zagrijavanja.
  - Postupak tindalizacije ubija bakterije bez uništavanja njihovih staničnih struktura
  - Rezultat: postbiotici – **neživi mikroorganizmi koji zadržavaju svojstva korisna za zdravlje**
  - Strukture stanične stijenke, fragmenti membrane i izlučeni metaboliti ostaju netaknuti i biološki aktivni

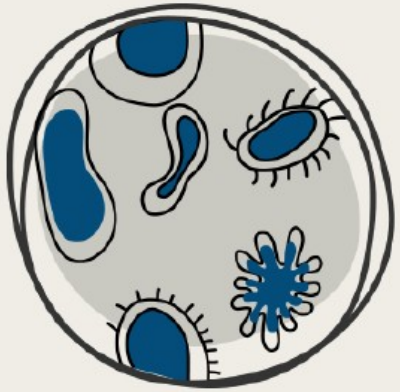
3P robiotics rebiotics ostbiotics

The making of postbiotics

Tyndallization process is an effective method designed to inactivate probiotics.



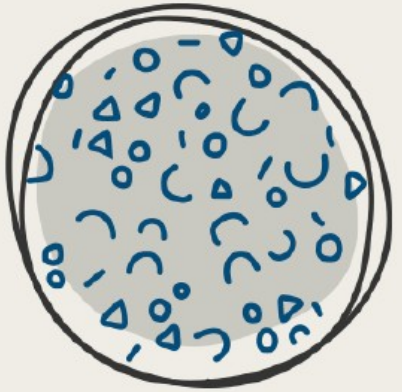
Sastav postbiotika



Microbial cells or
the remains of beneficial
bacteria



Fragments or structures of
microbial cells such as cell walls
and cell membranes



with or without
metabolites/endproducts
(Organic acids, peptides, secreted
proteins, enzymes,
bacteriocins, etc.)

POSTbiotici kao bioaktivni posrednici

Moduliraju imunitet, jačaju cjelovitost barijere i potiču ravnotežu mikrobioma, sve bez potrebe za aktivnošću živih bakterija.

- Imunomodulacija: pojačavaju lučenje IgA, jačaju urođeni i stečeni imunitet, reguliraju upalne citokine i podupiru uravnotežen imunosni odgovor u stresu.

- Jačanje crijevne barijere: poboljšavaju cjelovitost čvrstih spojeva, smanjuju crijevnu propusnost i potiču otpornu sluzničnu barijeru.

- Potpora mikrobiomu: stabiliziraju korisne skupine mikroba i ublažavaju promjene mikrobiote uzrokovane stresom.

- Funkcija probavnog sustava: poboljšavaju redovitost i konzistenciju stolice, probavnu ugodu i ukupnu probavnu podnošljivost.

- Protuupalni i metabolički učinci: smanjuju upalne biomarkere, podupiru zdrav metabolizam lipida i pridonose sustavnoj metaboličkoj ravnoteži.

Piqué N, Berlanga M, Miñana-Galbis D. Health Benefits of Heat-Killed (Tyndallized) Probiotics: An Overview. *Int J Mol Sci*. 2019;20(10):2534. Published 2019 May 23.

Postbiotici – dodatak probioticima

Nova potpora uz antibiotisku th.

Studije su pokazale da Lactobacillus rhamnosus CRL1505 može:

- pojačati urođene imunosne odgovore
- povećati aktivnost makrofaga i dendritičkih stanica
- potaknuti stvaranje interferona-γ (IFN-γ)
- poboljšati otpornost na respiratorne virusne i bakterijske infekcije

POSTbiotici kao bioaktivni posrednici - dokazi

The Concept of Postbiotics

Gabriel Vinderola [1], Mary Ellen Sanders [2], Seppo Salminen [3]

Affiliations + expand

PMID: 35454664 PMCID: PMC9027423 DOI: 10.3390/foods11081077

Abstract

The scientific community has proposed terms such as non-viable probiotics, paraprobiotics, ghostbiotics, heat-inactivated probiotics or, most commonly, postbiotics, to refer to inanimate microorganisms and/or their components that confer health benefits. This article addresses the various characteristics of different definitions of 'postbiotics' that have emerged over past years. In 2021, the International Scientific Association for Probiotics and Prebiotics (ISAPP) defined a postbiotic as "a preparation of inanimate microorganisms and/or their components that confers a health benefit on the host". This definition of postbiotic requires that the whole or components of inactivated microbes be present, with or without metabolic end products. The definition proposed by ISAPP is comprehensive enough to allow the development of postbiotics from different microorganisms, to be applied in different body sites, encouraging innovation in a promising area for any regulatory category and for companion or production animals, and plant or human health. From a technological perspective, probiotic products may contain inanimate microorganisms, which have the potential to impart a health benefit. However, their contribution to health in most cases has not been established, even if at least one probiotic has been shown to confer the same health benefit by live or inanimate cells.

Keywords: ISAPP; International Scientific Association for Probiotics and Prebiotics; heat-inactivated probiotics; inanimate; microorganisms; non-viable probiotics; postbiotics; probiotics.

Postbiotics: The concept and their use in healthy populations

Gabriel Vinderola [1], Mary Ellen Sanders [2], Seppo Salminen [3], Hania Szajewska [4]

Affiliations + expand

PMID: 36570166 PMCID: PMC9780264 DOI: 10.3389/fnut.2022.1002213

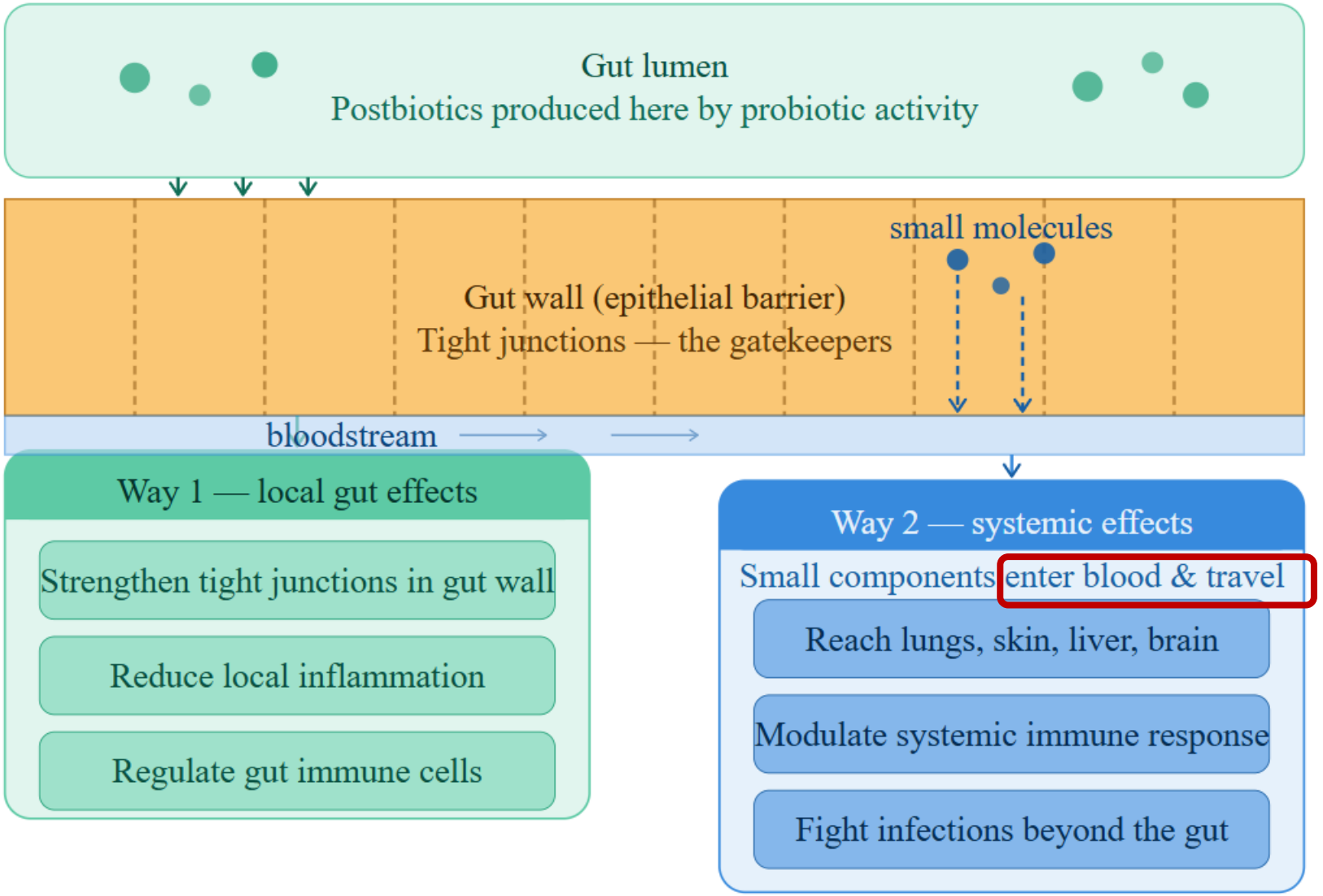
Abstract

The term postbiotic was recently defined by an panel of scientists convened by the International Scientific Association of Probiotics and Prebiotics as "a *preparation of inanimate microorganisms and/or their components that confers a health benefit on the host.*" This definition focused on the progenitor microbial cell or cell fragments, not just metabolites, proteins or carbohydrates they might produce. Although such microbe-produced constituents may be functional ingredients of the preparation, they are not required to be present in a postbiotic according to this definition. In this context, terms previously used such as paraprobiotics, ghostbiotics, heat-inactivated probiotics, non-viable probiotics, cell fragments or cell lysates, among others, align with the term postbiotics as conceived by this definition. The applications of postbiotics to infant nutrition and pediatric and adult gastroenterology, mainly, are under development. Some applications for skin health are also underway. As postbiotics are composed of inanimate microorganisms, they cannot colonize the host. However, they can in theory modify the composition or functions of the host microbiota, although evidence for this is scarce. Clinical results are promising, but, overall, there is limited evidence for postbiotics in healthy populations. For example, postbiotics have been studied in fermented infant formulas. The regulation of the term postbiotic is still in its infancy, as no government or international agency around the world has yet incorporated this term in their regulation.

Keywords: clinical studies; definitions; healthy population; microbiome; postbiotics.

1. Vinderola G, Sanders ME, Salminen S, Szajewska H. Postbiotics: The concept and their use in healthy populations. Front Nutr. 2022;9:1002213. Published 2022 Dec 9. doi:10.3389/fnut.2022.1002213
2. Vinderola G, Sanders ME, Salminen S. The Concept of Postbiotics. Foods. 2022;11(8):1077. Published 2022 Apr 8. doi:10.3390/foods11081077

POSTbiotici djeluju uglavnom na dva načina



J.E. Aguilar-Toalá, R. Garcia-Varela, H.S. Garcia, V. Mata-Haro, A.F. González-Córdova, B. Vallejo-Cordoba, A. Hernández-Mendoza, Postbiotics: An evolving term within the functional foods field, Trends in Food Science & Technology, Volume 75, 2018, Pages 105-114, ISSN 0924-2244, https://doi.org/10.1016/j.tifs.2018.03.009.

Klinička područja primjene 3P kombinacije:

PREBIOTIK + PROBIOTIK + POSTBIOTIK

SVAKODNEVNA PRAKSA

Antibiotska terapija
Prevencija proljeva uz antibiotike
Odabrani probiotici

Eradikacija H. pylori
Potpora podnošljivosti terapije
Odabrani probiotici

IBS, nadutost i zatvor
Individualna procjena
Neujednačeni dokazi

GASTROENTEROLOGIJA

Ponavljajući pouchitis
Prevencija recidiva
Određena probiotička formula

Upalne bolesti crijeva
Trojna kombinacija: istraživanja
Bez rutinske preporuke

OSTALE SPECIJALNOSTI

Pulmologija
Os crijeva–pluća: TB i NTM
Dodatna potpora u istraživanju

Dermatologija
Atopijski dermatitis
Istraživanja odabranih probiotika

Endokrinologija
Dijabetes tipa 2
Istraživanja sinbiotika

WGO 2023. AGA 2020/2024. Kang et al. 2026. Giorgio et al. 2026. Sinbiotici u dijabetesu: PMID 39719724.
TB = tuberkuloza. NTM = netuberkulozne mikobakterije. Istraživačka područja nisu rutinske indikacije trojne kombinacije.

Primjer koristi dostupnog postbiotičkog soja:
L. rhamnosus CRL 1505 HI

ISTRAŽIVANJE: 80 zdravih ispitanika, 8 tjedana, usporedba s placebom.

Primjeri praćenih simptoma



NOS I GRLO

- Začepljen nos
- Nelagoda u grlu



OPĆE STANJE

- Umor
- Zimica



PROBAVNE TEGOBE

- Mučnina / žgaravica
- Nelagoda ili bol u trbuhu



GLAVNI NALAZ

Manje kumulativnih dana sa simptomima u odnosu na placebo.

Nalaz za istraživani CRL1505 pripravak, ne za cijelu ATB formulu.
Fujiki et al. Jpn Pharmacol Ther. 2023;51:941–949; opis simptoma: JP2025139721A, primjer 5.

Svijet -biotika

NOVOST BROJ 2

Je li S.bulardii dobio konkurenciju?

Kluyveromyces marxianus kao *saccharomyces* nove generacije pokazuje privlačna probiotička svojstva

New generation probiotics: combining probiotic and biotechnological potential of *Kluyveromyces marxianus*

Marta Rogalska [1], Katarzyna Kmita [1], Aleksander Gryciuk [1], Agata Kaczmarek [2], Anna Katarzyna Wrońska [2], Jolanta Mierzejewska [1,✉]

▸ Author information ▸ Article notes ▸ Copyright and License information

PMCID: PMC12647324 PMID: 41286368

visok antioksidativni potencijal,
antifungalno djelovanje,
značajan udio β-glukana

Rogalska M. New generation probiotics: combining probiotic and biotechnological potential of *Kluyveromyces marxianus*. *App. Microbiol.techn* 2025;109(1):245

K. marxianus B0399: kvasac u višeslojnoj formuli

Kvasac s identitetom soja



3 – 4 sata
od antibiotika

ŠTO JE ISTRAŽENO?

- Maccaferri i sur., 2012.
- Stanični sustavi Caco-2 i PBMC.
- Laboratorijski model kolona.
- Nalazi opisuju svojstva konkretnog soja.

ŠTO TO ZNAČI ZA PRAKSU?

Kvasac proširuje sastav kombinacije.



Preživljava u uvjetima probavnog sustava (kiseline, žuč)

Može se vezati za crijevne stanice

Pokazuje antioksidativno djelovanje

Ima antifungalna svojstva

Može utjecati na imunitet i crijevnu mikrobiotu

Key features of K. marxianus B0399

Differences compared to probiotic bacteria	Differences compared to common yeast like S.bulardi
Eukaryotic cell	Enzymatic profile: B-galatosidase (lactose), inulinase (inuline, FODMAPs etc), glucanase (glucans)
Resistant to gastric environment	Present in common milk products
Naturally resistant to antibiotics	Considered safe by GRAS &, without any exception (S.boulardii is contraindicated for patients of frail health & for patients with a central venous catheter; EFSA Panel 2007)

Prednost kombinacije 3P



Umjesto zaključka.....

stiže nam era

TRIBIOTIKA

Pacijentima u infekciji ponudimo TRIBIOTIK jer <u>važno je</u>:

ZAUSTAVITI antibiotikom uzrokovan proljev

REKOLONIZIRATI – „požar u crijevima" ima dugoročne zdravstvene posljedice!!

POMOĆI IMUNITETU– i probioticima i postbioticima